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CONTENTS.

	Page.
ILLUSTRATED ARTICLES:	
The Hochhausen Multiple-Series Cut-Out	186
The Stockwell Electric Motor	187
An Improved Wheatstone Rheostat	188
An Arc Lamp Indicator	188
A New Arrangement of the Quadruplex	188
The Sprague System of Electric Motors	189
The Phonopore	191
The Twin-Sheave Electric Cable System	192
A New Magneto Call-Bell	193
The Tabony Time Register	193
On an Experiment Showing that a Divided Electric Current may be Greater in Both Branches than in the Main	194
REVIEWS OF NEW BOOKS:	
"Short Lectures to Electrical Artisans"	186
"Theory of Magnetic Measurements"	186
"Supplement to the Steam Engine Catechism	186
"Square Root Made Easy"	186
CORRESPONDENCE:	
An Amateur Dynamo Builder	193
EDITORIAL PARAGRAPHS	185
MISCELLANEOUS:	
Fire Office Rules in London	186
The Electric Light and the Eye	186
Applying for Subway Space	187
Dielectric Fluids	187
Western Union Affairs	188
Electricity in Soap and Bleaching Works	190
Subway Litigation	190
The Daft Motor and the Electric Railway at Baltimore	192
A Misleading Paragraph on "Telegraphic Frauds"	192
Fluorine by Electrolysis	193
An "All-Round" Battery	193
DEPARTMENTS:	
New York Notes	194
New England Notes	194
Western Notes	195
The Telegraph	195
The Telephone	195
The Electric Light	195
Applications of Power	195
Personals	195
Miscellaneous Notes	195
Sparks and Flashes	196
Stock Quotations	196
Business Notices	196
Our Illustrated Record of Electrical Patents	196

New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

	Page.
J. H. Tabony.—The Tabony Time Register	xi
Wyckoff, Seamans & Benedict.—The Remington Standard Typewriter	xii
Waterbury Electric Co.—Magneto Bells, Electrical Apparatus.	xiii
The "Twin-Sheave System" for Electric Cables and Wires	xiii
Van Depoele Electric Mfg. Co.—Electric Motors and Electric Railway System	xiii
Johnston's Patent Agency	xiv
Sawyer-Man Electric Co.—Plans and Estimates for all Kinds of Incandescent Lighting	xv
W. J. Johnston.—New Electrical Books	xvi & xvii
Western Electric Co.—Electric Bells, Push Buttons, Annunciators, etc	xviii
Want and For Sale Advertisements	xi

Vol. VIII. NEW YORK, OCT. 16, 1886. No. 16.

A NEW YORK hairdresser says that gas-light, with its heat, is the cause of nearly all the modern baldness, and he advances good reasons for his views. This is the unkindest cut of all.

IT is strange to note that not long since the French Société d'Encouragement offered a prize of 3,000 francs "for an apparatus strongly and simply made which should announce automatically and in a certain and regular manner the passage of a train in motion at any required distance." We think that a number of American firms would be willing and able to equip all the French railways with devices of that nature which would satisfy the conditions imposed, our columns having but recently contained a description of such a device.

THE latest "point" in regard to the alleged purchase of Baltimore & Ohio telegraph stock by Mr. Pender, is that the purchase is denied by Mr. Pender and Mr. Garrett. It is also denied by Mr. de Castro, of the Commercial Cable Company, that there is any idea of a concession to the Western Union Company. Hence the only new condition that gives cause for the greater strength of Western Union stock is the addition of Mr. Austin Corbin to the directorate. Many will think that no small reason.

THE valuable facts established by the use of the steam engine indicator have led to many improvements in the construction and operation of the engine, and to no other instrument is the progress in this direction more attributable. With the same object in view, an arc lamp indicator has been constructed on somewhat analogous principles, the revolving barrel or cylinder, marking pencil, etc., being present in this case also. As shown on another page, much valuable information may be obtained from the indications, which include the essential points in a good arc lamp.

THE general activity in the electrical field is probably not less manifested on the literary side than any other. The new books out or to be published make a goodly show both for variety and for usefulness, as will be seen from the special announcements appearing in our columns today. The recent and new literature includes works on static electricity—a fascinating subject not half explored; the transmission of energy; electric lighting; magnetic measurements; electric motors; lectures to electrical artisans; and popular treatises on electricity. Here is evidently something for all.

OUR European contemporaries make appropriate note of the hundredth anniversary of the first important discovery by Luigi Galvani. It was on Sept. 20, 1786, that Galvani, then a professor at the University of Bologna, and experimenting for the time on the terrace of the Zamboni Palace, made his celebrated observations on the contracting limbs of frogs. It is not for us now to discuss the extent of Galvani's acquaintance with static and dynamic electricity, but we may commend the zeal with which in the spirit of the true scientist he carried on his researches, and the recognition now given to his work in the monument by Cencetti, erected to his memory at Bologna, where he was born in 1737, and where after a useful and laborious life he died in 1798. Galvani was a Columbus in electrical discovery and is worthy these honors.

THE curious properties developed in the study of alternating currents, especially in relation to their inductive effects, are daily multiplying. The most recent of these is that brought forward by Lord Rayleigh and described in another column, in which it is shown that under certain conditions an electric current may be greater in both branches than in the main. The apparent paradox here involved is explained by him to be brought about by the mutual induction between the wires which, if the rapidity of alternation of current is great enough, will entirely neutralize the magnetic effect, leaving only the mutual induction between the adjacent wires to act and to predominate over the primary current. When this is the case, the resistance of the wire disappears as a factor. A phenomenon similar to the last-mentioned is also brought out in the arrangement known as the "phonopore," in which rapidly vibrating currents are shown to have great powers of overcoming the resistances in telegraph lines.

VARIOUS competitive tests have been made of electric lighting systems from time to time, chiefly in America, and with more or less satisfaction on the part of those concerned. Such tests always awaken considerable interest, for the reason probably that most people still take pleasure in a fight, and like to see the principle of the survival of the fittest put to some kind of ocular demonstration. The echoes of the Franklin Institute tests of incandescent lamps and dynamos have not yet died away from the air when a competition of like importance is proposed in arc lighting. The American Electric Manufacturing Company, with the courage of their convictions and no small pride in their system, have made an extensive and comprehensive challenge to other systems on all points wherein superiority can be determined, and, with a keen sense of the fitness of things, they propose to devote the balance of the stakes to the relief of the earthquake sufferers. The losers in such a trial would certainly have a warm appreciation of the evils of a "sharp and sudden shock." The plan of the competition appears to be that of running lamps and machines continuously for thirty days. The winners would be fairly entitled to think well of their system after that test of endurance and efficiency. The lists remain open for a month from October 1. We await developments.

THE constantly recurring opinions given by medical men attesting the superiority of the electric light over gas as an illuminant, must long since have settled any dispute which could be provoked in reference thereto. The latest observations, however, not only confirm the early views a ken, but go still farther in that they are based upon the results of a longer experience. Dr. Andrews, ophthalmic surgeon to one of New York's largest hospitals, gives his unqualified opinion of the superiority of the incandescent light. During an extended practice, he has not noted a single case of impaired eyesight due to its use. He seems, however, to regard the arc lamp as not yet fit for illumination on account of its *brilliancy* and *unsteadiness*. So far as the first objection is concerned, we think that the doctor has viewed the question from the standpoint that the arc lamp is used as an illuminator of interiors, where the eye is necessarily placed in rather close proximity to it. There may, probably, be some truth in this, but we fail to see how the view can be held in reference to the arc lamp employed as a street illuminator. Here the conditions of close proximity of the eye to the lamp do not exist, and the objection must necessarily fall away. As regards the unsteadiness of the arc light, this is purely a matter of carbons and of constructive detail. Lamps can be, and are, made which burn with absolute steadiness, and which with improved carbons leave nothing to be desired on this score. While, therefore, the doctor may be correct in stating as a generality that an unsteady arc lamp is injurious to the eyesight, there is no reason to infer that steadiness in an arc lamp is unknown.

THERE are many signs that the revival of electric lighting in England has begun, in spite of the tremendous obstacles that are placed in the way of those who desire to engage in the business. The fact that the industry is as a whole in good shape to-day bears no small testimony to the bulldog tenacity and genuine "grit" of our British cousins. The men who have held on through the days of trial deserve our sympathy and praise, and it is only to be hoped that new and reasonable legislation will soon be given them as aid and stimulus in the arduous work still before them. Calling attention to the fact that the Maxim-Weston Company in London has doubled its business during the last twelve months, and now to meet the contracts offering has to make a new issue of 10,000 shares, our English contemporary, the *Electrical Review*, commends its action, and wishes it all success—as do we. The London journal says also: "Our columns week by week testify to the general extension of electric lighting, and there seems every promise that such of the companies as remain in the field and are not so encumbered as to involve themselves the more deeply the more business they undertake, will find plenty of work to occupy their attention. * * * We have every confidence that the healthy revival of electric lighting as a genuine industry will not be long delayed; in fact, it is our belief that it is now in progress." The fact is, English electricians and companies have done their best in the only fields that remained open to them, that of isolated arc and incandescent lighting in works or residences, and that of special lighting on shipboard. If now, the unfair legislation against electric light enterprises of the larger kind is removed, or even if the English gas companies undergo conversion as the American gas companies are doing, we shall see central stations in every part of the country.

WHILE America is not by any means backward in matters that relate to the practical applications of electricity, it must be owned that in so far as the means and facilities for prosecuting electrical research are concerned she lags behind the older countries of Europe. We say, advisedly, the "facilities," because there can be no doubt that we have physicists in this country who are able to undertake thoroughly original researches, but in many instances they are deterred therefrom by the lack of funds which such undertakings necessarily require. In Europe, on the contrary, numerous richly endowed institutions offer the means for desirable ends, and the results obtained are manifest in the large amount of original work accomplished. In numerous instances the government has come to the aid of science and established institutions designed to regulate and establish standards in electrical measurement, where, at a trifling cost, and in some cases without any charge whatever, information is given out, and work of great industrial importance is performed. We need only cite as an instance the public electrical laboratory recently established at Munich by the Bavarian government. It will undertake experimental work, including all the principal practical applications of electricity. Another of its objects, however, will be the testing of electrical appliances, which may be submitted by manufacturers and others. Such an institution must prove of great value, and we strongly advocate the founding of a similar one among us. If we consider the large sums of money expended annually by different parties striving to attain the same object and probably following the same course of experiment, we can form some idea of the capital and labor, not to speak of the time, wasted at present. Again, the existence of a laboratory where an impartial test would be guaranteed would be the best means of sifting out the good appliances from the poorer ones, and thus of raising the standard of production generally. Enough has been said to show the desirability of founding such an institution, and our scientists and manufacturers ought to combine for the purpose of soliciting the aid of the government in this matter. We are convinced that a properly conducted Bureau of Electrical Standards and Tests will be at least self supporting.

REVIEWS OF NEW BOOKS.

Short Lectures to Electrical Artisans. By J. A. Fleming, M. A., D. Sc. New York: E. & F. N. Spon. Illustrated. 8vo. Pp. 206. Price, $1.50.

These lectures were delivered by Dr. Fleming last winter before the pupils and workmen connected with the firm of Mr. R. E. B. Crompton, at whose suggestion the course was undertaken. The author remarks in his preface that they "were not in any way intended as a connected exposition of even elementary principles of electro-technics," but they have, in spite of this modest disclaimer, a very evident logical continuity of thought and treatment. The lectures present as a whole a skillful exposition of the subject, leading up from stage to stage of principle and practice, and illustrating each new point of discussion and explanation with care, thoroughness and originality. So genuinely scientific are most portions of the book, one might at first wonder how it was that Dr. Fleming found an appreciative audience. But the truth is that electrical artisans, whether in Europe or America, are as a body possessed of no small amount of intelligence and that the successful working of many applications depends upon their high standard of mental culture and manual dexterity. It would not be asserting too much to go further and say that from their active brains have sprung many of the ideas now at the foundation of a great number of electrical industries.

The lectures deal with magnetization, permanent and electro magnets, electrical measurements, dynamos, motors, induction coils, secondary generators, primary and storage batteries, and all other matters falling within their scope. We can heartily commend the book to our readers, many of whom will find it extremely useful in clearing up doubtful matters, in giving answers to inquiries that they hardly knew how to frame, and in suggesting fresh fields of work and study.

Theory of Magnetic Measurements, with an Appendix on the Method of Least Squares. By Francis E. Nipher, A M. New York: D. Van Nostrand. 1886. Pp. 94, 5″ × 7½″. Price, $1.00.

This useful little work is intended as a brief exposition of the methods pursued in the details of a practical magnetic survey. As the author states, it is designed to supplement the instructions of the Coast and Geodetic Survey, and as such it gives the various methods of obtaining the values of the magnetic inclination, declination and horizontal intensity. The instruments used for this purpose by the United States Coast Survey are described and illustrated, and the appendix describes the manner of reducing the observations by the method of least squares.

Supplement to the Steam Engine Catechism. By Robert Grimshaw, M. E., New York: John Wiley & Sons. 1886. Pp. 195, 4½″ × 6″. Price $1.00.

As the title indicates, this is a supplement to the author's Steam Engine Catechism, and the method pursued in the treatment of the subject is analogous to that previously adopted. In this volume particular attention has been paid to compound engines, link motions, the details of various existing types of steam engines, and to matters concerning setting up, running, adjusting, etc., the different builds of engines. The book is illustrated wherever necessary, and will no doubt prove useful to young engineers.

Square Root Made Easy. By Robert Grimshaw, M. E. New York. Published by *Mechanics*, 1886. Pp. 32, 4″ × 5½″.

The author, well known as a "practical man," with little favor for theory and mathematics, has sought to present the method of obtaining the square root of a number in a simple manner, so that every mechanic shall be able to employ it when occasion requires. We must admit that for a popular *exposé* he has succeeded admirably in making clear the process involved in this (to some) perplexing calculation.

Fire Office Rules in London.

The eighth edition of the Phœnix rules has just made its appearance, and contains the regulations which have been adopted for the use of secondary generators. They are as follows: "Where secondary generators are employed and the alternating primary current is of high electromotive force, it is preferable that neither the secondary generators nor the portion of the primary circuit in connection with them be placed inside any building, but in a fireproof structure apart. When, however, this cannot conveniently be done, the following precautions must be observed: The primary conductors must be heavily insulated with india rubber of the highest quality, or other approved equally good material or materials, and must have a very strong external covering, and the insulation resistance must be very high, and to the satisfaction of the inspector from the fire office. The conductors must be kept at a minimum distance of twelve inches from each other, and be inclosed in separate casing. The casing should be of a non-conducting material and fireproof, and the arrangement must be such that no leakage of electricity can take place to earth from either of the conductors, or any short circuit from one to the other. The primary conductors must be furnished with a double-pole switch, and also double-pole 'cut-outs' which act at 25 per cent. above the normal and placed as near the entrance of the primary conductors into the building as possible. The switch-board must be of slate or other approved non-combustible material, and placed in a secure position. The secondary generators must be encased in iron, or be in a fireproof compartment, and placed as near the entrance of the primary conductors into the building as can conveniently be done. They should be in a dry situation and thoroughly insulated. All secondary conductors must be protected by double-pole 'cut-outs' to go at 50 per cent. above the normal, to be approved by the inspector from the fire office. Where from the nature of circumstances it is found impossible to follow out any part or parts of these safeguards, then the inspector from the fire office will decide as to what shall be done in each particular case as it arises. The casings for the primary conductors must be fireproof from their entrance into a building up to the 'cut-outs.' Should, however, it be desired to use a non-fireproof casing from the 'cut-outs' to the switch and secondary generators, special permission must first be obtained."

The Hochhausen Multiple-Series Cut-Out.

The practice of running incandescent lamps on arc-circuits seems to be meeting with considerable favor, and

Fig. 1.—Hochhausen Multiple Series Cut-Out.

especially so in the case of isolated plants where arc light machines are installed. The incandescent lamps are then arranged in multiple series, so that if the arc lamp employed were of 50 volts and 10 ampères its place would be taken by 10 incandescent lamps of 50 volts in parallel circuit, each requiring 1 ampère. But when so arranged, means must evidently be provided by which, if a lamp breaks or is turned out, an equivalent resistance is introduced, so that the current remains constant in the other lamps.

Such a switch has recently been designed by Mr. Wm. Hochhausen, the electrician of Excelsior Electric Company. It operates automatically, in case of the break-

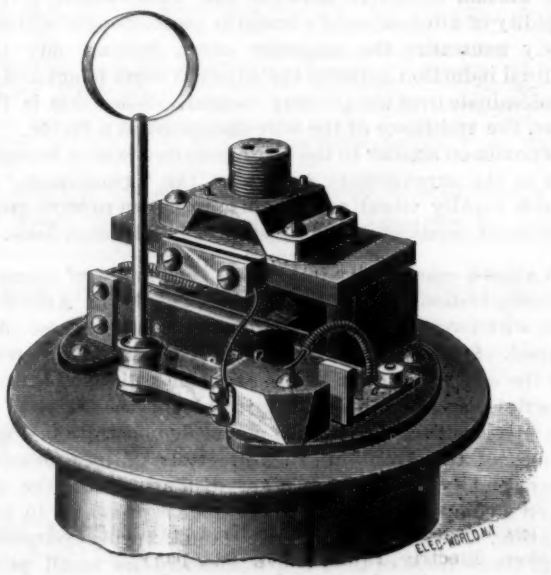


Fig. 2.—Hochhausen Multiple Series Cut-Out.

age of a lamp, but at the same time serves as the switch for extinguishing it at will. The arrangement is shown complete in the engraving, Fig. 1. When in use, it is screwed to the ceiling, the lamp being suspended from it by flexible cord. Fig. 2 shows the switch with the cover removed, exposing the interior arrangement. Within the long cylinder there is placed a second one covered with asbestos, upon which is wound a helix of bare German silver wire, the resistance of which is equal to that of the lamp when hot. The armature opposite the electro-magnet shown forms one terminal of the resistance, and its back contact the other, both being mounted with platinum contact points. The resistance is thus shunted around the lamp. The coils of the electro-magnet are in series with the lamp; hence it follows that when current is turned on, by raising the rod provided with the ring at its end, the magnet is energized, attracts the armature, and breaks the circuit of the resistance coil, thus cutting it out. The current then passes entirely through the lamp. When it is desired to extinguish the latter, the rod and ring are pulled down. This breaks the circuit through the lamp; the magnet being no longer energized it allows the armature to be drawn back by a spring, and to complete the circuit of the resistance at the back contact; the current then passes through the resistance. When it is desired to extinguish all the lights of a series, a separate switch is provided, so that all the lamps including resistances are cut out of circuit.

It will be noted that the base upon which the electro-magnet and accessories are mounted extends a short distance beyond the outer cylinder, and that the latter is also open at the other end. This allows the air to circulate freely and prevents the resistance coils within from becoming unduly heated. The whole arrangement is neatly designed, and is quite ornamental in appearance.

The Electric Light and the Eye.

In a paper read at the recent meeting of the American Ophtbalmological Society, Dr. J. Alfred Andrews, ophthalmic surgeon to the Charity Hospital, New York, gave an interesting account of the effects of strong light on the eye, with special reference to the electric light. We extract the following:

"So far all the cases of injury to the eye from the electric light recorded in medical literature have resulted from exposure of the eye in close proximity to the arc electric light, and this has, in every instance, been of a very intense brilliancy, generally that used for street illuminating purposes—two thousand candle-power—which may be actually fifteen hundred candle-power. In many of these cases a pre-existent abnormal condition of the eye was not excluded.

"So far as I have been able to ascertain, no case of accident to the eye has been reported as having been caused by the incandescent electric light. Of the 1,100 persons whom I have examined and observed during the past year who work by day or by night for many hours by the incandescent electric light of Edison's lamp, there was not a single instance of injury to the eye; but, on the contrary, I was surprised to find that a considerable number of these persons, with a high degree of myopia and choroidal changes, were absolutely comfo.table while working by this light, and they expressed themselves as having experienced a great improvement in the condition in their eyes since they had begun to work by the electric light (Edison lamp of twelve to sixteen candle-power), always shaded from the eyes, the light being thrown down upon the work from a short elevation. Many persons among typesetters and copyists have told me that formerly, when gas was in use in the establishment in which they worked, they went home from their work with their eyes red, watering and aching, and this was especially the case among short-sighted persons, but that they could work longer by the Edison light (the arc light distressing them), and without discomfort. Of course, every form of artificial light is more or less dazzling when the source of light casts its image on the retina. We certainly can avoid this dazzling in the gas or petroleum flame by means of an appropriate shade; but, in order to secure the requisite amount of illumination, we must either approach the light close to the head, and thereby expose the eyes to the undesirable radiant heat, or increase the illumination at a greater distance, and thereby make an increased demand upon the vital parts of the atmospheric air in the room, thus vitiating the latter, which is a very undesirable equivalent. The amount of heat radiated by the electric light is very unimportant; and when, after sunlight, we add to its unrivaled qualities as an illuminator the steadiness and absence of combustion from the incandescent lamp of Edison—there being, therefore, no consumption or vitiation of the atmospheric air induced by it—together with the practical clinical fact that it is a greater comfort for even persons with existing eye affections to work by this light than by any other artificial illuminator, we must, from a therapeutic point of view, concede to the incandescent electric light advantages not possessed by any other artificial means of illuminating; and any one who has given the subject thoughtful consideration will at once see the great blessing which would come from introducing this kind of light into our night-schools, theatres, public halls, and those innumerable counting rooms in this great city where large numbers of human beings work by artificial light during the entire day or night, the demand upon the atmospheric air by the individuals alone being, in the absence of adequate means of ventilation, and in the majority of instances very little ventilation at all, in these overcrowded places, terrible enough without the additional mischievous agent in vitiating the atmospheric air present in the many gas flames. The advantage of using the incandescent light in our ophthalmoscopic dark chamber must be evident to every ophthalmic surgeon."

Dr. Andrews' conclusions are as follows:

The arc electric light is not so objectionable on account of its intense brilliancy, which can be modified by means of an opal or ground-glass shade or globe.

The gazing at the arc lamp for many seconds is attended with great risk to the eyes. The arc light, in its present

state, should be positively rejected as unsuitable and actually harmful to the human eye, particularly on account of its unsteadiness.

The incandescent light of Edison, because of its steadiness, adequate power and composition, is safe, and occupies at present the first position as a means of artificial illumination. By its use the accommodation of the eye is less taxed than by other illuminators.

The light may advantageously be placed on the table in front of the person using it, but it should never shine directly into the eye, but always be completely hidden from the eyes by means of an opaque shade made of glass or tin, and the light be thrown down upon the work. For obvious reasons, it is further believed that the incandescent electric light is especially beneficial to hypermetropes and myopes.

The Stockwell Electric Motor.

At the recent electric light meeting at Detroit, the interesting fact was brought out that more than 5,000 electric motors of all sizes are in operation in this country at the present time. Among those mentioned as being largely in use was the Stockwell motor, which has for some time been employed in the running of light machinery, especially sewing machines, and it is said that not less than a thousand of these are in actual service to-day.

The motor, which we illustrate in the engraving, Fig. 1, is inclosed within a case, one end of which is removed so as to expose the interior. The magnets are of the converging, consequent pole type, and form an integral part with the top and bottom of the casing. The two sides are cast separate and held together by screws.

The armature, or more correctly the armatures, for there are two of them, are shown in Fig. 2. As will be seen they are of the Siemens shuttle-wound type, and are placed at right angles to each other. The commutator has four segments and the terminals of the wire on each armature are connected to opposite segments. The latter are not made parallel with the spindle, but are helical in shape, so that there is no break in the circuit at that point, since the brush passes the current to one armature before leaving the other. By this arrangement only one armature is in action at one time. Taking the one to the right, for example, it is at its maximum effect during the quarter revolution, when the polar faces of the armature are approaching the pole-pieces, and until they come directly opposite each other. During the next quarter revolution the armature is cut out of the circuit entirely; on the third quarter it again comes into the circuit until occupying the same relative position as in the first quarter; and, finally, in the fourth quarter it is again cut out. But it is evident that during each of these idle periods of the armature to the right, that to the left comes into circuit and goes through relatively the same cycle of operations. The action is quite analagous to that in two steam engines coupled with their cranks at right angles to each other. While one is passing over the centre, and practically doing no effective work, the other is in the position of maximum power, with the crank at right angles to the line of stroke. In both cases, there can be no dead point, and the motion is smooth and continuous.

Where motors are applied to machinery required to be run at different speeds, some method of regulation becomes necessary, and in the present instance this has been worked out in a very simple manner. Where the motors, as usual, are connected in series with each other, an adjustable resistance is provided which is contained within a box, such as that shown in perspective in Fig. 3 and in section in Fig. 4. This adjustable resistance is placed in a shunt to the motor and consists in a series of carbon bars of gradually decreasing conductivity. As the switch lever is passed over the successive contacts, increasing resistances are introduced in the shunt, which consequently allows more current to pass into the motor and increases its speed correspondingly. The spring attached to the switch lever keeps the latter in the position of "no current" in the motor, and by attaching a cord or other device connected to a treadle the operator on a machine has both hands free to work with.

The carbon resistance bars are copper-plated at their ends and firmly clamped, and by making them of gradually decreasing cross-section a relatively greater increased resistance is thrown into the circuit as the switch-lever passes from one contact to another. A wide range of control is therefore afforded with a comparatively limited movement of the lever.

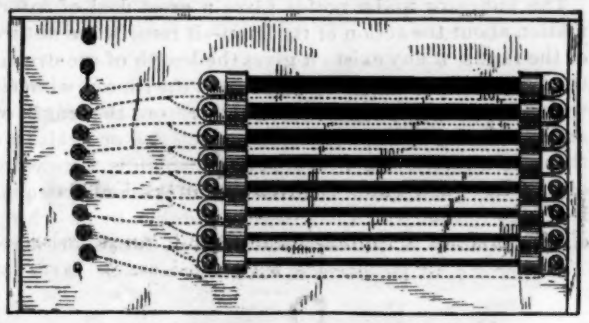
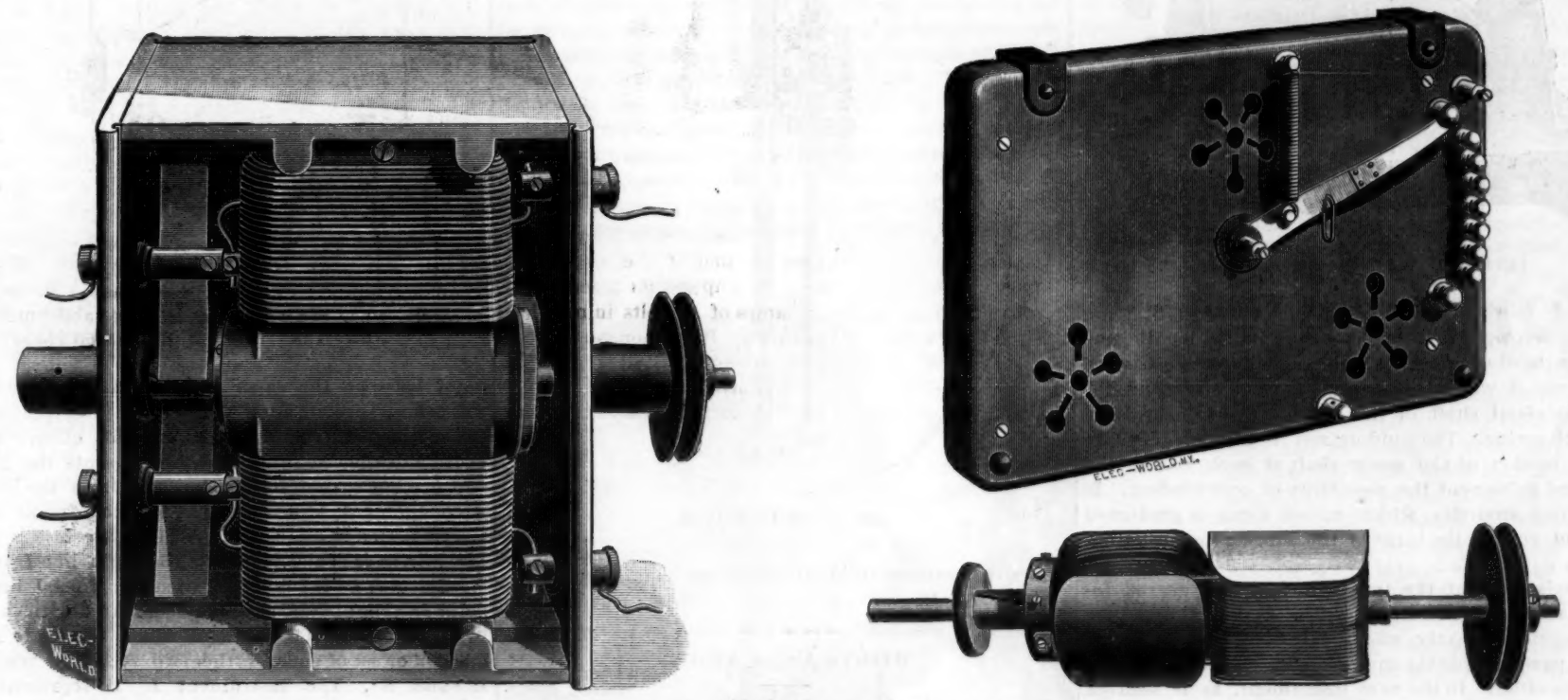


FIG. 4.—DIAGRAM OF RESISTANCE BARS.

The motor is provided with a clamp so that it can be readily attached to a table or work bench, and its simplicity of construction makes it little liable to get out of order.



FIGS. 1, 2 AND 3.—THE STOCKWELL ELECTRIC MOTOR.

Applying for Subway Space.

The indications are that the Subway Commission will be kept busy attending to applications for space in the new subways. The Western Union Company has again admitted the constitutionality of the commission by asking for certain facilities and concessions from it. Mr. E. H. Goff appeared in person last week for the American Electric Manufacturing Company, desiring to string wires on Third avenue between One Hundred and Sixth and One Hundred and Sixteenth streets, on Eighth avenue between One Hundred and Twenty-third and One Hundred and Twenty-seventh streets, and through One Hundred and Twenty-fifth street. This was referred to Commissioner Jacob Hess, to whom the following also were referred: The application from the Harlem Electric Illuminating Company, to string wires wherever their business demanded; from the Fifth Avenue Safe Deposit Company to effect a connection with the Twenty-ninth Precinct, and from 100 citizens of Harlem, who have formed a company and granted the use of their roofs and houses for a Business Men's Telegraph Messenger Service on First, Second, Third and Fourth avenues and through One Hundred and Twenty-fifth street.

A communication was received from Col. Rowland R. Hazard, President of the New York District Railway Company, stating that the company was going to put an underground railway under Broadway, and requesting an inspection of its plans for a tunnel as being suitable for a receptacle for telegraph and telephone wires.

Superintendent Smith has applied for room for the fire alarm wires, and the Metropolitan Telephone Company has completed a satisfactory negotiation, so that both of these systems of wires will be put in the Dorsett section next week. The telephone wires will occupy ten times the space required by the Western Union Telegraph Company.

At the completion of the first section a test case will be made, and all the poles on Sixth avenue about Twenty-fourth street will be ordered down. It is expected that the Western Union Company will make no opposition, as it is said that Judge Dillon, one of their counsel, has submitted an opinion that it would be useless to attack the constitutionality of the bill creating the commission, as any possible errors would be at once rectified by the incoming Legislature. If, however, opposition was made, the case would go at once to the courts, but the Western Union Company could carry it by slow stages up to the Supreme Court, and years might elapse before a final decision could be given. This state of affairs would probably put a stop to conduit building for some time. But the Commissioners, through Engineer Kearney, have made an offer to the Western Union Company to lay for its use the style of conduit it prefers, but no preference has been expressed. In case any company is disposed to object to the material employed, Mr. Flower offers the following test: Any telegraph company may lay a half mile of naked wire in the present conduit, and test its insulating qualities. It is guaranteed that this severe test will be successful. Wires were run through all the ducts from Twenty-fourth to Fortieth street on Oct. 11, and no obstruction was found. No electric test, however, was made.

The Commissioners assert that their chief concern has been to complete a conduit from Central Park to the Battery before the cold weather sets in, and they say that the delay has not been their fault.

The section from Cortlandt street to the Battery, which is to be a tunnel, will be built under Broad and Nassau streets to Maiden lane, and through that street and Cortlandt street to New Church street, where the new central office of the Metropolitan Telephone Company will be situated. This tunnel can be built in cold weather, but there is little prospect of effecting a connection with Twenty-fourth street and Sixth avenue. It looks as if no company could get ready before spring.

The orders to the police about what they should do with persons found stringing new telegraph and telephone wires have been further modified on opinions of Corporation Counsel Lacombe that the police are to respect permits from the Subway Commission to the Metropolitan Telephone and Telegraph Company, and that the Subway Commissioners have power to decide whether the wires should be put under ground or not.

In the Superior Court, Special Term, last week, Judge Freedman listened to arguments on the motion of the Electric Lines Company for an injunction to restrain the subway commissioners and the Consolidated Telegraph and Electrical Subway Company and its contractors from trespassing on spaces in the streets which the Electric Lines Company claims to have pre-empted for the purpose of laying conduits. He also heard argument on the plea of the subway commissioners that they are State officers, and as such cannot be restrained by an order made by any other court than the Supreme Court, General Term. Decision was reserved.

Dielectric Fluids.

Prof. G. Quincke, continuing his studies of the properties of dielectric properties of fluids, publishes, in the last number of the *Annalen der Physik und Chemie*, some results of experiments with very high electromotive forces. By means of a Holtz machine and a long-range electrometer, the observations have been carried up to 30,000 volts. Prof. Quincke finds that an apparent exception to the law of Ohm occurs under these conditions, inasmuch as the strength of a steady current through the fluid increases more rapidly than the electromotive force which

produces it. It was also observed that with high electromotive forces the dielectric constant (the inverse of specific inductive capacity) is less than with lower forces; in other words, there exists an apparent tendency to saturation in inductive capacity.

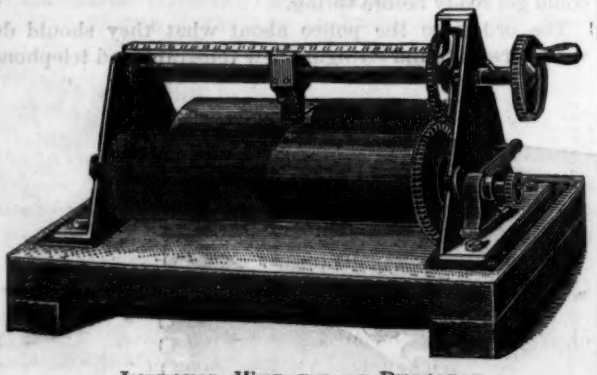
An Improved Wheatstone Rheostat.*

BY SIR WILLIAM THOMSON.

Wheatstone's rheostat was invented over 40 years ago; but, though admirable in conception, and commonly shown on the lecture table in illustrating and explaining the nature of electric resistance, it is scarcely, if at all, used in the laboratory. This is altogether owing to practical defects in the instruments as commonly constructed. The wire comes loose, the contacts are uncertain, and, the current being incessantly broken and made again, the galvanometer needle is perpetually swinging about instead of showing a continuously increasing or diminishing deflection as the resistance is wound out of the circuit or wound into it.

Modifications of the original instrument have been made from time to time, and a very important improvement was recently introduced by Mr. Jolin, of Bristol. In Jolin's rheostat a toothed wheel, fixed on one of the two cylinders, gears into a toothed wheel on a shaft carrying the other cylinder, and a spring fixed to this shaft acts on the last-named cylinder, which surrounds it on the principle of the main spring of a watch. By this arrangement the wire is kept tightly stretched, and the barrels can be turned both forward and backward by means of a handle attached to one of them, and the necessity of shifting the handle from one to the other when the motion is to be reversed is obviated.

In the improved rheostat the spiral groove in the non-conducting cylinder of previous instruments is dispensed with, and the wire is guided between the cylinders so as



IMPROVED WHEATSTONE RHEOSTAT.

to be laid on them spirally by means of a traveling nut on a long screw. The screw is turned by the handle, and carries a toothed wheel, which gears into two toothed wheels, one of which turns one of the cylinders, and the other the aërial shaft of the other cylinder containing the watch spring. The guiding nut is also arranged to stop the motion of the screw shaft at each end of the range, and so prevent the possibility of overwinding. It also carries an index, which moves along a graduated scale, and counts the turns of the wire on the insulating cylinder.

In Jolin's rheostat the two cylinders are geared together, as already described. The two cylinders are geared together directly, and turn in contrary directions, the wire passing from the upper side of one to the under side of the other. In the new instrument, as is seen in the illustration, the toothed wheels of the two cylinders are turned in the same direction by the wheel on the screw shaft, and the wire passes horizontally from the top of one cylinder to the top of the other.

The conducting cylinder and the wire are both of platinoid, a metallic alloy having properties which make it specially suitable for the purpose. It has very high electric resistance, very small temperature variation of resistance, and it remains with its surface almost or altogether untarnished in the air. On account of the last-named property the contact between the wire and the conducting cylinder is as perfect as can be desired; and continuity of action, which was a great difficulty in the old form of the instrument, is absolutely perfect.

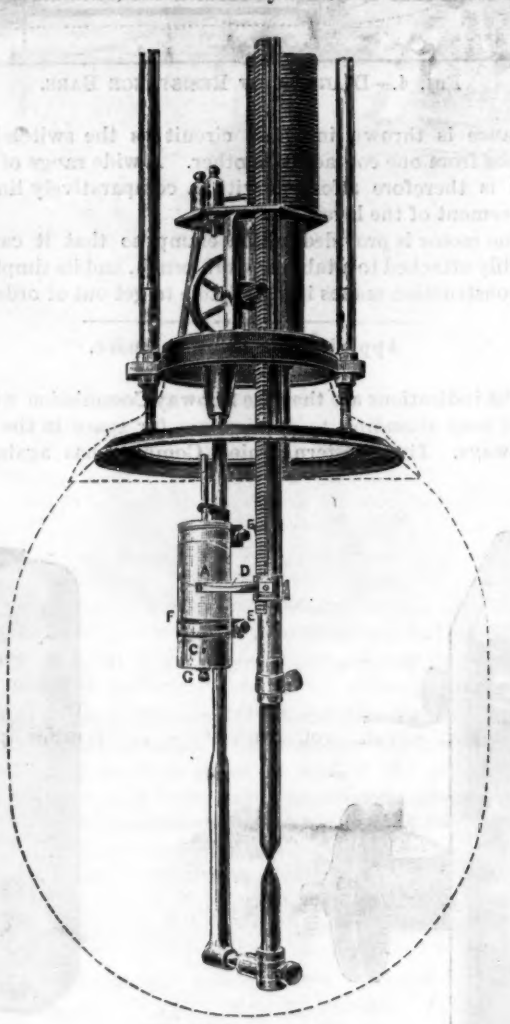
An Arc Lamp Indicator.

This is an instrument for recording the feeding of arc lamps. Our engraving, taken from *Industries*, shows one of these indicators attached to an arc lamp, ready for working. The instrument consists of a brass cylinder *A*, capable of revolution in a frame and driven by clock-work. The clock work is contained in the case *C*, and turns the cylinder *A* one complete revolution per hour. *D* is a light arm carrying a pencil.

The instrument is fixed by clamps *E E* to the negative rod, or any convenient part of the lamp, the axis of the driven cylinder *A* being placed parallel to the positive rod of the lamp. An indicator paper is wrapped completely round *A*, and is held by india-rubber bands *F F*. The arm *D* is clamped to the positive rod, and presses its pencil lightly on the paper. The carbons being still in contact, the cylinder is turned through a complete revolution by turning the button *G*, the pencil describing a line round the paper corresponding to the atmospheric line of the steam engine indicator. This is called the "striking line."

The apparatus is now ready for action, and nothing remains but to switch on the current to the arc lamp and leave it to burn an hour or more. If the feeding of the carbons is uniform, the rate of fall of the arm *D* will be constant, and the path described by the pencil will be a spiral, which, on opening out the paper, appears as a straight, sloping line. All movements of the arm *D* will be recorded.

The indicator under notice gives a great deal of information about the action of the lamp—it records the *nature* of the faults, if any exist; it gives the length of arc struck, the size and character of each feed, and the time at which it took place. At any moment we may record the length of arc existing by switching the current off and on again; we then get a vertical line, the length of which is a measure of the length of the arc. The arc re-struck should be equal in length to that which has just been broken by switching off. If it is not, the distance by which it falls short is recorded. The consumption of carbon per hour is also recorded by this instrument.



ARC LAMP INDICATOR.

Western Union Affairs.

Great attention is still being paid by Wall street to the affairs of the Western Union Company. One of the new sensations last week was the announcement that Mr. Austin Corbin would join the Western Union directorate when the annual meeting takes place. This information was given out officially. Many theories were built upon it. Mr. Corbin has loomed up as an important man in the financial world of late. In being placed at the head of the Reading Railroad under the new reorganization scheme, he will represent great interests having more or less relation to the Reading Company. And one of the conclusions that Wall street jumped at, says a daily contemporary, was that his entrance into the Western Union directory means peace in telegraph circles. As the President of the Reading, Mr. Corbin will necessarily have intimate relations with the Baltimore & Ohio Railroad people. He and President Garrett are personal friends. It is not unnatural, therefore, that Wall street should seem to see a somewhat closer approach in the relations of the Western Union and Baltimore & Ohio Telegraph companies. It is urged that Mr. Corbin can do the mutual friend diplomacy business, and bring Mr. Garrett and Mr. Gould to treat through him. But all this was only guessing. Officials of the Western Union Company insisted that no change in their company's policy was proposed.

As to the cable situation, the subjoined comes from Mr. H. De Castro, the Vice-President of the Commercial Cable Company:

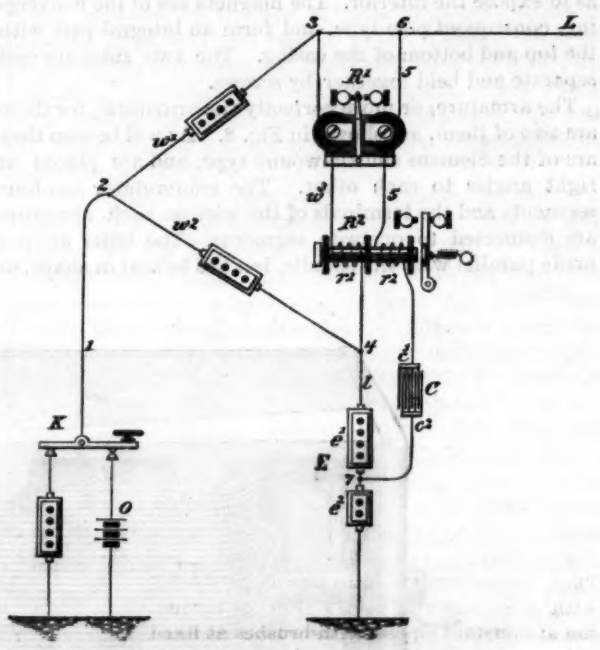
"The recent rumors regarding the cable war having called forth many inquiries from our friends and customers, we take opportunity to say that in so far as the statements made relate or allude, remotely or otherwise, [to the Commercial Cable Company or any of its officers, they are absolutely false from first to last. We desire to state in the most emphatic manner that the Commercial Cable Company is not for sale, and that its officers or any one acting by their authority, either directly or indirectly, have not engaged in any negotiations nor made or received any proposals whatever for any arrangement with the pool or other company or individual. Following our policy we shall continue our unremitting efforts to protect the public from exorbitant rates by maintaining a first-class, speedy and independent cable service, relying upon the support which has and is being so generously accorded us by our friends and patrons."

This is a flat denial of the various stories afloat, but does not seem to satisfy some people.

A New Arrangement of the Quadruplex.

There has recently been introduced on the lines of the Baltimore & Ohio Telegraph Company a new arrangement of the quadruplex devised by Mr. Wm. Maver, Jr., and designed to more perfectly overcome or counterbalance the effects produced by the static discharge of the main line.

The arrangement consists, in general terms, in applying to the coils of the receiving-instrument supplementary or additional coils included in a conductor extending from the main line to one plate of a condenser, the remaining plate of which is connected with the artificial line at a



NEW ARRANGEMENT OF QUADRUPLEX.

point between the earth and a portion of the artificial resistance.

The accompanying diagram explains clearly the connection of the circuits. Here *L* represents the main line and *K* a key system for transmitting from the battery *O*. A conductor 1 leads from the key to a point 2, where the two arms w' and w^2 of a Wheatstone bridge diverge. The arm w' is connected with the main line *L* at a point 3. The arm w^2 is connected with an artificial line *l*, at a point 4. The points 3 and 4 are connected with each other by a bridge-conductor w^3, in which there are included one coil or set of coils of the two receiving instruments R' and R^2. The instrument R' is represented as a polar relay, and is provided with a second set of coils included in a conductor 5 leading from a point 6 in the main line to a plate c' of a condenser *C*. The instrument R^2, which is represented as a neutral relay, is also constructed with two coils r' and r^2, the former of which is included in the bridge conductor w^3, as already stated, while the second coil r^2 is included in the conductor 5. The remaining plate c^2 of the condenser is connected with the artificial line *l* at a point 7, intermediate between the two sections e' and e^2 of the artificial resistance *E*, employed for equalizing the line resistance. The coils of the instruments R' and R^2 are so connected in the conductor 5 that the effects of the discharge of the condenser through them shall tend to neutralize the discharge of the main line. It will be readily understood that the charge taken by a condenser will depend upon the difference in potential of the points 6 and 7, with which the respective plates are connected. For this reason a portion e' of the resistance *E* is located between the point 7 and the bridge, and the greater the amount of this resistance the greater will be the charge taken on by the condenser. It is desirable, also, that a portion of the artificial line resistance shall be between the point 7 and the earth.

It will be apparent that when a current is transmitted from the battery *O* to line a charge will be received by the condenser *C*. The discharge of the line *L* will tend to produce a false signal by traversing the bridge-conductor w^3. The current or impulse from the plate c' upon the discharge of the condenser *C*, however, will neutralize the effects of the line-discharge in the receiving instruments. It is also apparent that by a simple arrangement the resistance e^2 could be obtained from the coils of the

* Read at the Birmingham Meeting of the British Association.

rheostat used to form an artificial line in duplex or quadruplex telegraphy, thus dispensing with the expense of additional rheostats.

The Sprague System of Electric Motors.

Since the days of Pacinotti it has been known that dynamos and motors are reversible, and it is now known that it is almost impossible to put any assemblage of copper and iron together which, when a current is passed through it while in a magnetic field, will not show some evidence of motion. For some years past dynamo construction has been carried to a very high degree of efficiency, and machines have been built which would convert 96 per cent. of the mechanical energy delivered to them into electricity. Yet notwithstanding this fact and the assertion of Prof. Rowland that the best dynamo must be the best motor, in other words, that the best apparatus for converting mechanical power into electricity must be the best apparatus for converting electricity into mechanical power, a statement which on its face carries the elements of truth, electric motors have remained for a long time a subject concerning which most literature was sadly at fault, both the theory of the motor, a knowledge of its action, and its practical application being remarkably limited. One of the causes perhaps of the difficulty of handling this subject has been that most motor experiments have generally been conducted with crudely made dynamo machines and without any definite idea of the relations that exist in the different parts of the circuit. The terms electromotive force, potential, current, and resistance, in their relation to what is commonly called the counter electro-motive force and to each other, have not been at all generally understood, nor even the law of the electro-magnet until Deprez and Hopkinson began their researches on the saturation of iron. Even to-day well-known scientific men differ on this latter law, and go astray in reaching practical results by an excessive refinement in mathematical researches.

Deprez in Paris, Ayrton and Perry in London, and Sprague, among others, in the United States, have been the most active in developing the true theories of motors. Of the latter little was known in this line until the fall of 1884, when the Electrical Exhibition was held in Philadelphia. Mr. Sprague had for some time before this been pushing his researches with energy, and at the Philadelphia Exhibition exhibited a number of machines which were the first of the kind ever shown. These machines were run on an Edison constant potential circuit. They were thrown into circuit gradually with a very strong rotary effort or torque, ran at constant speed with brushes at fixed points, and without any evidence of sparking, under all loads from the minimum up to the maximum allowed. These machines were a revelation to men like Thomas A. Edison, Sylvanus P. Thompson, and Mr. Preece, and in the various comments which were made on the performance of these machines, their unique character was recognized. In addition to those machines, Mr. Sprague showed others, one of which, starting under a heavy load, could be made to run forward or backward, fast or slow, at will, the reversal being made with an ease and rapidity and freedom from sparking which were remarkable. Another machine could be made to run in either direction, and was provided with adjustments so that it could be made to run at different determined constant speeds under varying loads. Since the exhibition of these machines, all of which were experimental and many of which are now in practical use, Mr. Sprague's progress in this work has been remarkably rapid. Some idea may be obtained of the operation of some of the different classes of machines built under the Sprague system from the following general explanations:

A motor when running may be looked upon as a dynamo machine propelled by a current: it has a field magnet like any other dynamo, it has an armature situated in that field which, either because of the attraction and repulsion of the lines of force, or of the double attraction and repulsion of the poles which are set up in the armature acting on the poles of the field magnet, is caused to rotate. This armature rotating in the magnetic field has an electromotive force developed in it which is precisely of the same kind as would be developed were the motor driven by a belt instead of by a current. The strength of this electromotive force depends upon the resulting strength of field and the speed of the armature. This electromotive force, which may be termed a *motor* electromotive force, is ordinarily called the counter electromotive force because it is opposed to that of the line current which is flowing into the motor. The difference between this line electromotive force and that of the motor is what may be called the effective electromotive force, and determines, in combination with the resistance of the circuit, the strength of current which will flow in a circuit into which these elements enter. In any case of a single transmission from a dynamo to a motor the combination of these two determines the differences of potential which exist in the different parts of the circuit, which difference of potential determines the strength of current which will flow in any derived circuit. This counter electromotive force likewise determines the efficiency of a motor or a system of transmission of power.

Motors may be described as belonging to one of three different systems. First, those in which the field magnet is excited by a coil in parallel circuit with the armature, that is, in shunt relation thereto; second, those in which the field magnet is in series with the armature circuit; and third, those in which there is a combination of these two circuits. There are in addition a very large variety of each of these classes, different conditions demanding different performance. Furthermore, similar machines may be placed upon three different kinds of circuits, their performances varying widely in each case. These three conditions are: First, the case of special transmission with varying potential and current; second, constant current circuits in which the main current is kept at a constant quantity, and third, constant potential circuits. The special transmission of power, unless carried out under certain well-defined laws based either upon a constancy of current or constancy of potential at some definite part of the circuit, is unsatisfactory, but if made according to a law no difficulties present themselves.

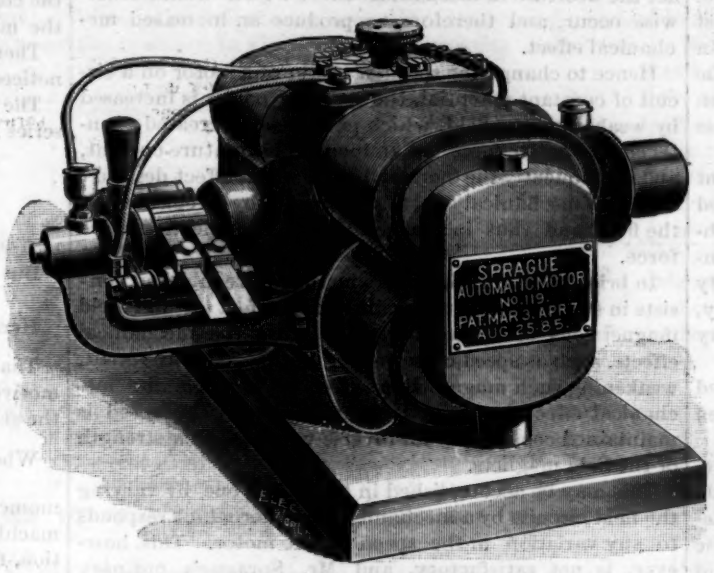


FIG. 1.—SPRAGUE ELECTRIC MOTOR.

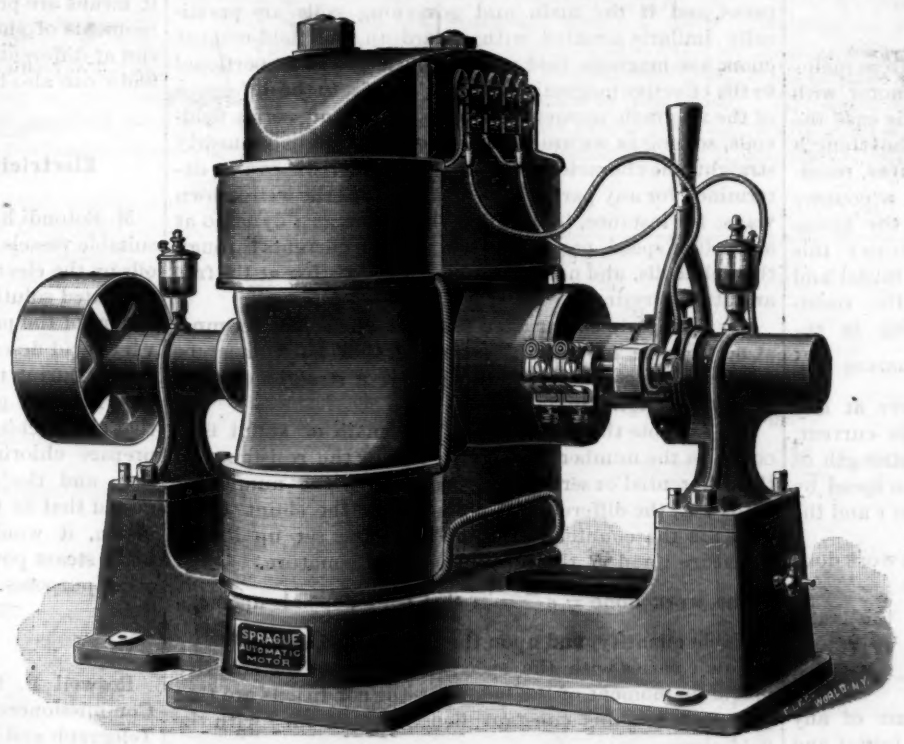


FIG. 2.—SPRAGUE ELECTRIC MOTOR.

We will briefly consider the action of these different kinds of machines on two classes of circuits only. First, on the constant current circuit. If a series wound machine be placed upon such a circuit, the same current passing through the field magnet, it will develop a constant torque, which torque is directly proportional to the strength of the field magnet and to the current in the armature. If the mass of iron is sufficiently great, this torque will be directly proportional to the effective ampère-turns in the field magnet, and the work done will be directly proportional to the speed. If the machine be at rest there will exist a difference of potential at the terminals of the machine equal to the product of the current and the resistance of the machine. When running, however, an electromotive force will be developed in the machine and the potential at the terminals of the machine will rise by the same increment. The work done may be likewise expressed by the product of this counter electromotive force and the current, or $e\,C$, and is independent of the resistance of the machine. The resistance, however, determines, in combination with the other elements, the total efficiency of the motor. The total energy expended is the product of the difference of potential existing at the terminals of the motor and the current flowing, or $E\,C$. The efficiency then is $\frac{e\,C}{E\,C}$, or $\frac{e}{E}$, and the heat wasted $(E - e)\,C$.

When running at any particular speed the work will be increased directly as the field magnet strength is increased. So also will be the economy. The heat wasted with any given resistance in a machine under these conditions is a constant. The direction of rotation of such a machine can be reversed by reversing either the armature circuit or the field circuit; if both circuits are reversed, then the machine will run in the same direction. For many classes of work this kind of machine is exceedingly useful, because it admits of a great range of hand control. If such a machine, however, be put on ordinary work, and this work be lightened up, the machine will run faster and faster, and unless the field is weakened or the brushes are shifted to check it, the speed will practically increase without limit. Every change of speed and every change of load is accompanied by a corresponding change in the potential which exists at the terminals of the machine. Moreover, on a constant current, the motors being in series with each other and with lamps, this continual variation of potential is apt to cause trouble on the circuit, especially if the machines are not automatic, since, as already stated, with any fixed field the torque is constant, the work done is directly proportional to the speed. The machine has the highest efficiency when running at the highest speed.

With shunt machines, however, the action on the constant current circuit is much different. Here the current is divided in two circuits, such division, when the motor is at rest, being inversely proportional to the resistances of the two parts of the circuit. With such a motor, the field is weakest when the machine is at rest, and its torque or rotary effort is also very weak. If the load be not too great, as the speed of the machine increases a counter electromotive force is set up, the potential at the terminals of the armature and field magnets rises, the current in the armature diminishes, and that in the field magnet increases. Provided there is sufficient iron in the field magnets, the torque or rotary effort will vary in a decreasing ratio until one-half of the current is flowing through the field magnet. At this moment the machine will be doing its maximum amount of work, and at less than 50 per cent. total efficiency. If the work be lightened, the machine will increase its speed until, when the work is entirely removed, there will be practically no current through the armature; all will have been shunted through the field magnets, and the potential at the terminals of the machine will be at the maximum. Such a machine will do the same total work at two different speeds and efficiencies.

If a machine be wound with a double set of coils, it will behave very much the same as a shunt machine does, its field magnet being strengthened in a more or less rapid ratio, or being kept constant, depending upon whether the series coil is cumulative or differential.

Because of the fact that constant current circuits in ordinary use deal with small currents and very high electromotive forces, and do not admit of such perfect regulation, Mr. Sprague has preferred ordinarily to work the constant potential circuits, although some of his machines are running on the constant current circuits for other than automatic work, that is, for work where the speed is under control and where the work done for a given speed is constant.

There are two ways by means of which a constant current motor can be governed. One consists in automatically changing the counter electromotive force by changing the position of the brushes on the commutator to positions more or less removed from their normal one. To this objection is offered because the proper position for the brushes of any machine is at the points of least sparking. The other method consists in varying the counter electromotive force by automatically weakening the field as the load is diminished, or strengthening it as the load is increased. Several methods have been proposed for doing this, generally by the action of a centrifugal governor. To this also many objections are raised. Mr. Sprague, desiring to get rid of all such rapidly moving adjuncts to motors, is now engaged on a totally new system which promises, he thinks, entire freedom from these defects.

On constant potential circuits the behavior of these different classes of motors is entirely different.

A plain series wound motor when there is sufficient iron

in the field has a torque proportional to the square of the current flowing through it. It is capable of exerting a great rotary effort and doing a large amount of work at a slow speed. The range of speed for different loads is, however, great, and the motor is entirely unfitted for ordinary work where steadiness of speed is an object; as the load is diminished, the speed increases and, if thrown off entirely, the motor will run faster and faster, the field continually growing weaker and the armature all the time accelerating its speed in a vain attempt to generate an electromotive force equal to the initial. For some classes of work, this kind of a machine, with some essential modifications, is exceedingly useful.

On the other hand, the shunt-wound machine will run fairly well on a constant potential circuit. The field, being excited independently of the armature, is constant, and since the load varies with the motor electromotive force, and the field is constant, it follows that the speed must vary with e. The torque is proportional to the current in the armature, and the speed will be slowest with the greatest load and fastest with the lightest, that is, when $e = E$. The lower the resistance of the armature, the less the variation in speed.

It is with the third class of motors, when used on constant potential circuits, that the difficulties which are involved in the governing of a motor entirely disappear, and, without the use of any such apparatus as centrifugal governors or movable contacts, it becomes possible to satisfy the most exacting conditions, both as regards efficiency, steadiness of running, power to start under very heavy loads, and freedom from sparking.

When Mr. Sprague first proposed his constant speed machines for constant potential circuits, he enunciated the following seemingly paradoxical proposition:

In a motor with the armature and field magnet independently supplied, the work which the motor will do in a given time, its economy and efficiency, are all independent of the strength of the field magnet, provided the translating devices intermediate between the motor and whatever is the recipient of its energy are not limited as to the rate of transmission of the motor speed; and that in all cases where a motor is working on a constant potential circuit and not up to its maximum capacity, in order to increase the mechanical effect either of speed or power, or both, or to compensate for any falling off of the potential on a line, it is necessary to weaken the field magnets, instead of strengthening them, and *vice versa*.

The strength of the field determines the speed at which a motor must run to get a required efficiency. With a given initial potential at the armature terminals, no matter how the load varies from the maximum allowed, the speed may be maintained constant by changing the strength of the field; such strength being diminished as the load is increased, and, *vice versa*, increased as the load is diminished.

These facts may be demonstrated as follows:

Let us consider the motor-current as derived from mains having a fixed difference of potential, and the motor with its field and armature in shunt relation. In this case the armature runs with a velocity dependent upon the strength of field, the initial potential, the number of turns, resistance, etc., of the armature, and the load, and a counter electromotive force is set up which regulates the armature-current. The higher the speed the greater this counter electromotive force. Let E be the initial and e the counter electromotive force, and r the resistance of the armature. The current flowing in the armature is then $\frac{E-e}{r}$. With a given armature and given field e varies with the speed. The power at any given speed and strength of field varies with the current, and with any given current varies with the strength of field. The total work done is the product of the speed by the work per turn, and since the speed is as e and the work per turn as the current $\left(\frac{E-e}{r}\right)$, the total work done is expressed by $\frac{e(E-e)}{r}$. The efficiency is the ratio $\frac{e}{E}$. It will be seen that both these expressions—the total work done and the efficiency—are independent of any function of the field, but depend only on the initial and counter electromotive forces and the resistance of the armature, and any given value of e can be attained with any strength of field by attaining proper speed.

Considering the speed of machine constant, its field alone being varied, and differentiating the expression for work done, $\frac{e(E-e)}{r}$, we have $\frac{de}{r}\left(E-2e\right)$ as the rate of variation of work.

It follows then that to maintain the speed constant with a current of constant potential under varying loads, when the load increases so that the speed would naturally decline, the field is weakened, the counter electromotive force diminished and armature-current increased, the tendency to reduced speed is counteracted, and there is an increase in the mechanical effect—power. For a decreased load the field is strengthened, the counter electromotive force increases, the current decreases, the speed remains the same, and the power is decreased.

To maintain speed or power constant under varying initial potential, if the potential at the motor terminals increases, these mechanical effects increase or tend to increase. By strengthening the field an increased counter electromotive force is produced, so that the increased power or speed, or the tendency thereto, is counteracted, and this counteraction may evidently be itself considered a decrease in mechanical effect, whether the regulation is performed simultaneously with the increase of potential or before or after such increase. If the regulation is performed simultaneously, with a gradual change of potential, there may be less change in counter electromotive force or armature-current; but there is still the counteracting of the tendency to increased mechanical effect, which counteracting is itself a decrease of mechanical effect. For a decreased or decreasing initial potential, the field is weakened to counteract the decrease in mechanical effect which would otherwise occur, and therefore to produce an increased mechanical effect.

Hence to change the speed or power of a motor on a circuit of constant potential, the speed or power is increased by weakening the field, which produces a decreased counter electromotive force and an increased armature-current, and consequently the increased mechanical effect desired; and such mechanical effect is decreased by strengthening the field, and thus increasing the counter electromotive force.

In brief, then, Mr. Sprague's method of regulation consists in strengthening the magnetizing effect of the field magnet coils of the motor to decrease the mechanical effects, such as speed or power, or both, and *vice versa*, weakening such magnetizing effect to increase the mechanical effects, and under varying loads the speed is maintained constant by an inverse varying of the strength of the field magnets.

This may be accomplished in two ways, one by varying the field circuits by a mechanical governor which responds to any variation in the speed of the motor. This, however, is not satisfactory, and Mr. Sprague's ordinary method of working is to make use of certain coils in series with the armature and dependent upon it, which coils have a resultant magnet action which is opposed to that of the main coils of the machine. While the main principle is the same, Mr. Sprague has a number of different methods of applying it. The first has a series coil in series with the armature, and its action in the above laws will be understood from the following description. All these machines, it should be said, could be used as constant speed machines on constant current circuits, provided the field coils are properly proportioned for the current which they would have to carry, but with certain disadvantages, as will be shown.

The magnetic moment of a coil may be defined as the product of the ampères flowing therein by the number of turns, and if the main and governing coils are practically similarly situated with regard to the field-magnet cores, the magnetic field may be considered as proportional to the effective magnetic moment; that is, to the difference of the magnetic moments of the shunt and series field-coils, so long as we are working on a straight or nearly straight line characteristic. This characteristic can be determined for any particular cores in any of the well-known ways; for instance, by running the motor as a dynamo at a constant speed, passing variable known currents through the field-coils, and noting the potential existing at the free armature terminals.

For a properly constructed motor the field magnet must at no time be too highly saturated, that is, it must be worked with a characteristic which is a straight or very nearly a straight line.

Let f denote the resistance of the main or shunt field coils; m the number of turns therein; r the resistance of the differential or series field coils and n the number of turns; E, the difference of potential at the shunt terminals; e the counter electromotive force set up in the armature; and R the resistance of the armature.

The work done $= e\frac{E-e}{r}$; that is, it depends upon e, a variable quantity, and upon the constants E and r.

Now e varies with the speed and field, or the effective magnetic moment of the field, but the conditions are that the speed remains constant, hence e must vary with the field alone.

Current in shunt field $= \frac{E}{f}$

Magnetic moment of same $= m\frac{E}{f}$

Current in series field $= \frac{E-e}{R+r}$;

Magnetic moment of same $= n\frac{E-e}{R+r}$

The effective magnetic moment must then be $m\frac{E}{f} - n\frac{E-e}{R+r}$; and the conditions are such that (for two different counter electromotive forces or two different loads)

$$\frac{e}{e^1} = \frac{m\frac{E}{f} - n\frac{E-e}{R+r}}{m\frac{E}{f} - n\frac{E-e^1}{R+r}}$$

$$\text{or, } \frac{e}{e^1} = \frac{m\,E(R+r) - n\,f(E-e)}{m\,E(R+r) - n\,f(E-e^1)}$$

$$\text{or, } \frac{e}{e^1} = \frac{m\,E(R+r) - n\,f\,E + n\,e\,f}{m\,E(R+r) - n\,f\,E + n\,e^1 f}$$

$$\text{or, } e\,m\,E(R+r) - e\,n\,f\,E + e\,n\,e^1 f = e^1\,m\,E(R+r) - e^1\,n\,f\,E + e^1\,n\,e\,f.$$

Canceling we have $e\,m\,(R+r) - e\,n\,f = e^1\,m\,(R+r) - e^1\,n\,f$,

$$\text{or, } m\,(R+r)(e-e^1) = n\,f\,(e-e^1)$$

$$\text{or, } \frac{m}{n} = \frac{f}{R+r}$$

That is to say, the number of turns in the shunt coil must bear the same ratio to the number in the series coil as the resistance of the shunt coil bears to the sum of the resistance of the series coil and the armature.

This is the Sprague law of winding for a machine of the kind mentioned, and so wound it will be self-regulating for any constant potential up to the maximum allowed by the construction of the machine, and from no load up to the maximum.

There is a feature of motors so wound which may be here noticed.

The ratio of the magnetic moments of the shunt and series fields is

$$\frac{m\frac{E}{f}}{n\frac{E-e}{R+r}} \text{ or, } \frac{m\,E(R+r)}{n\,f\,(E-e)}$$

But $\frac{R+r}{f} = \frac{n}{m}$

Hence the above ratio $= \frac{m\,E\,n}{m\,n\,(E-e)}$ or, $\frac{E}{E-e}$.

That is the ratio of the initial to the effective electromotive force is the same as the ratio of the moments of the shunt and series coil.

When $e = o$ this ratio becomes $\frac{E}{E} = 1$; that is, the moments are equal, and this means that, in a perfect machine, if both coils be closed and in their normal position, for any potential or current, a zero field, or practically so, will be formed, and the motor will either not start at all or if it does start will run at a very great speed, take the maximum current at any given potential and do little or no work at all.

How to obviate the bad effects of this peculiarity, yet to take advantage of it, will be shown later.

What has already been pointed out may be again stated, that the motor will regulate itself perfectly for all potentials so long as we work with a straight line characteristic, but it must be with a theoretical efficiency of not less than fifty per cent., for if we go below this, the governing coil works in the wrong direction.

Referring to the equation $\frac{m}{n} = \frac{f}{R+r}$, it will be seen that m and n can be increased in the same ratio. That is, if means are provided for varying the effective magnetic moments of shunt and series coils the motor can be set to run at different determined speeds. It is evident that f and r can also be varied to change the speed.

(TO BE CONTINUED.)

Electricity in Soap and Bleaching Works.

M. Rotondi has discovered that by the employment of suitable vessels it is possible to effect the saponification of oils by the electrolysis of an emulsion of the oil in a concentrated solution of sodic chloride. This, at least, is the nature of the process so far as can be gathered from a not very lucid description in one of the French technical journals. During the process it is said that caustic soda, free chlorine and glycerine are formed, and it is suggested that at bleaching works it would be found economical to prepare chlorine by this process in order to obtain the soap and the glycerine as by-products. It is also suggested that as the process requires practically no supervision, it would be practicable to employ in this way at night steam power already in use during the day-time for other purposes.

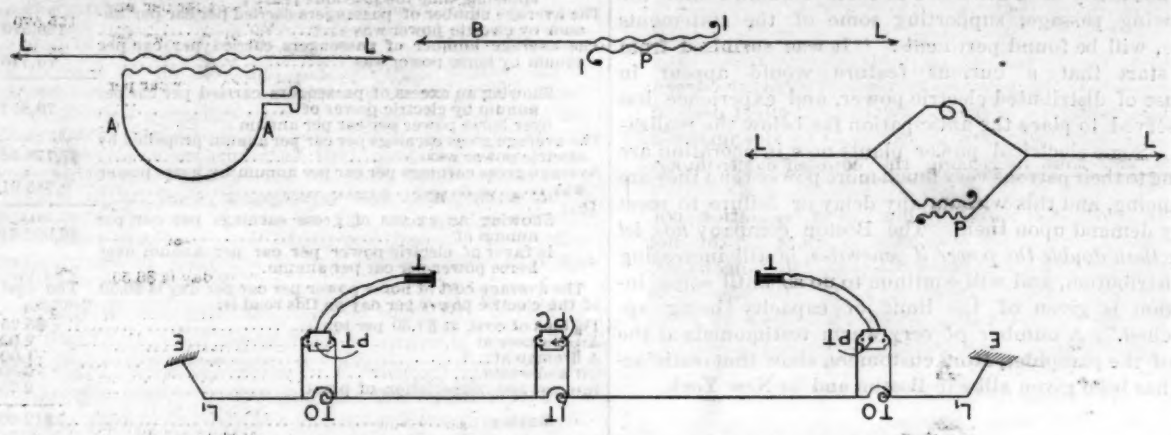
Subway Litigation.

Roswell P. Flower, Jacob Hess and Theodore Moss, Commissioners of Electrical Subways, the Consolidated Telegraph and Electric Subway Company, and Daniel H. Dorsett were served with summons on Oct. 12 to appear in the Second Circuit Court, in Equity, on the first Monday of November, to answer a bill of complaint entered by the North American Underground Telegraph and Electric Company. The North American company held a meeting on that day which was strictly private, but the action which followed showed that they have determined to proceed against all concerned in the present conduit-laying for infringements on their patents. George Harding appears as their solicitor. Lawyer Daniel L. Gibbens, counsel for the commission, after examining the summons, said: "I have not yet seen their bill of complaint. But their claim is that they have an exclusive right to the 'drawing in and out' system of laying conduits with convenient manholes. They say their patents cover the form, but not the material. Their patents, however, have never been tested in the courts, or they would have secured an injunction, but no injunction can be secured from the United States courts in cases of untested patents."

The Phonopore.

Several methods of transmitting telegraphic and telephonic messages simultaneously over the same wire have already been described by us, notably that of M. Van Rysselberghe. Recently, however, another method has been devised differing from the former in quite an essential manner.

The "phonopore," which is the invention of Mr. C. Langdon-Davies, of London, Eng., derives its name from the Greek words φωνη, sound, and πόρος, a passage. It is an appliance which may be described as a wire condenser, that is to say, a condenser in which the plates or armatures are of insulated wire laid side by side. Its nature may also be easily understood by likening it to an induction coil in which the primary and secondary circuits are employed like a condenser, or in other words, with one end of the wire free, so that there is no circuit for the current. More accurately



FIGS. 1 AND 2.—DIAGRAMS OF PHONOPORE CIRCUITS.

it consists, in the ordinary form at least, of two silk-covered wires bound together parallel to each other, by an outer covering of silk, like a two-wire cable, and wound in the same position on a bobbin. Two No. 30 B. W. G. copper wires, each 500 yards long, wound together on the bobbin, will, for example, make a phonopore; but, of course, the dimensions and form of the apparatus are varied to suit the special purpose for which it is intended. The wires, for instance, may be of a different gauge, length or material, and they may be twisted together in a strand instead of laid parallel, and so on. In the phonopore, however, we have two long conductors in close proximity but insulated from each other, and the electrical impulses in one are transmitted to the other with apparently no loss of power, at least for practical purposes. The metallic circuit, at the same time, is, of course, broken between the wires, by the intervening insulator.

Mr. Davies has found that this apparatus, while stopping the passage of the ordinary telegraph signal currents, allows the vibratory telephone currents to pass, and on this fact is based the system of simultaneous telegraphy and telephony which he has brought out.

This property of the device in question obviously enables him to superpose telephonic currents on a telegraph line, and to receive them at the distant end, or any intermediate point, or to translate them to another line, without interfering with the working of the telegraph.

The various systems based upon the phonopore are the following:

1. The combination of the telephone with the ordinary telegraph.
2. The combination of the phonoporic or vibratory telegraph with the ordinary telegraph.
3. The simultaneous transmission of several dispatches by means of the phonoporic telegraph.

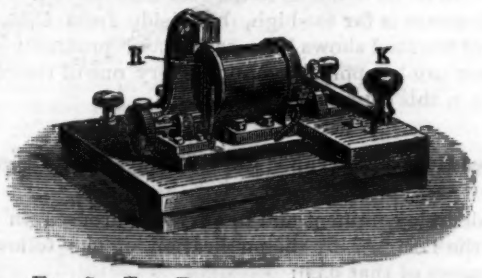


FIG. 5.—THE PHONOPORE TRANSMITTER.

The phonopore can also be employed for the purpose of establishing telephonic communication between two different lines, or for taking branch telephone circuits from the vibratory telegraph, for which purpose condensers are employed.

According to Mr. Davies, the introduction of a phonopore into a telephonic circuit reduces the effects of induction. Hence he winds phonopores around the bobbins of his telephone receivers. Our illustration, Fig. 1, represents some simple applications of the phonopore coil. In the first case, the primary wire *A* is in circuit with the telephone receiver, and the secondary with the line *L L*. In the second case the phonopore *P* is employed to connect the lines *B* and *L*; one end of each of the primary and secondary wires is left free, *I I*. In the last case, the phonopore *P* is placed as a shunt around a telegraphic apparatus, and serves as a passage for the telephonic or vibratory currents. These are the three simple arrangements of the phonopore.

A more complicated arrangement is shown in Fig. 2. Here the line L_1 L_1 includes three telegraphic sets *T O*, *T O*, *I T*. To these are connected the phonopores *P T*, *P T*, which connect the telephones *T*, *T* to the line, while *P C* serves as a passage for the telephonic message around the telegraph *I T*. This shows the manner in which a telephone or vibratory phonopore telegraph can be operated at the same time with the ordinary telegraph.

Fig. 3 represents two telegraph lines operated in the usual manner independently of each other with the ordinary telegraph apparatus *T O* and *I T*, while the phonoporic telegraph *K*, *S*, *P*, which is described below, operates between the stations Nos. 1 and 2 by means of the phonopore connecting the lines *P* and *C*.

We come now to the arrangement of the phonopore telegraph, as shown in Fig. 4, which represents diagramatically the installation at each end of the line, the portion to the left showing the connections of the transmitter, and that to the right the receiver. The line comes in at the binding-post *L*, and *E* is the ground connection, between which two points the ordinary telegraph is included direct, but not shown here, while the phonoporic telegraph is connected through the phonopore *P*.

Dealing first with the transmitter, we have the transmitting battery connected to the binding posts *B B* in circuit with a Morse signaling key *K*, a vibrating reed interruptor *R*, and the coil which actuates it wound on the core *N*, which is shown separately for the sake of clearness. The magnetism of the core keeps the reed in vibration, making and breaking the current by the well-known action seen in electric bells of the "trembler" class. The reed or interruptor, battery and Morse key are all in circuit with the primary of the phonopore, which is shown with three wires. It follows then that the intermittent current set up in this circuit by the vibrating reed and broken up into long and short Morse signals by the Morse key, acts through the phonopore from its primary to its secondary wires, the ends of which are insulated at *I I*. The impulses of the secondary traverse the line to the distant receiver.

The receiver, which, like the transmitter, is a similar construction at both stations, is connected at *R T*, *R T*, which are the receiver terminals. It consists of a vibratory relay, which is operated by the phonoporic impulses or vibratory signals from the line, and in turn works a telegraph instrument, such as the Morse sounder, by the aid of a relay and local battery. The way in which the vibratory signals work the relay is very interesting in itself, but it will be best understood, perhaps, after we have described the parts of the relay circuit. This comprises a battery *P*, which reinforces the action of the line impulses on a vibrating reed interruptor *R* when these impulses are passed through the electro-magnet *E M*. This is effected by a second auxiliary coil *A C* on the core of this magnet. The receiving coil *E M* is simply connected to the receiving terminals *R T*, *R T*, while the auxiliary coil *A C* is in circuit with the auxiliary battery *P*, the reed interruptor *R*, and the coils of the relay electro-magnet shown, which influences the tongue of the relay in opening and closing the local circuit, including the sounder *S*. A resistance *L R* is connected in the receiver circuit to assist in maintaining the constancy of the battery, and a galvanometer *L G* is also inserted to act as a current indicator.

Now the vibratory impulses from the line passing in the coil *E M* set the reed *R* vibrating, thereby interrupting the auxiliary current in the coil *A C*, which reinforces the effect of the impulses from the line. A vibratory current also traverses the coils of the relay electro-magnet, and the tongue of the relay closes the local circuit every time a signal passes on the line. The relay tongue operates in a continuous manner, not vibratory; that is to say, the tongue keeps the local circuit closed, whilst the vibratory signal current traverses the electro-magnet *E M*, or in other words, the relay responds to the signals of the line. The receiver or recording instrument in the relay local

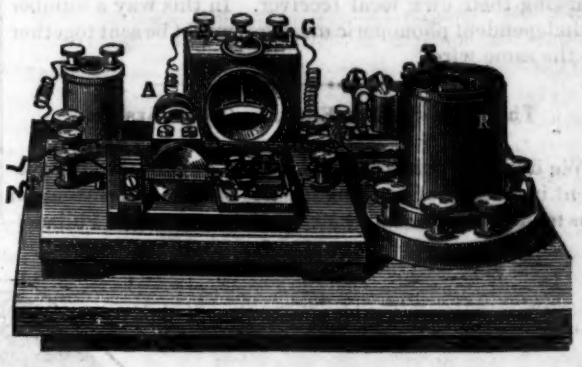


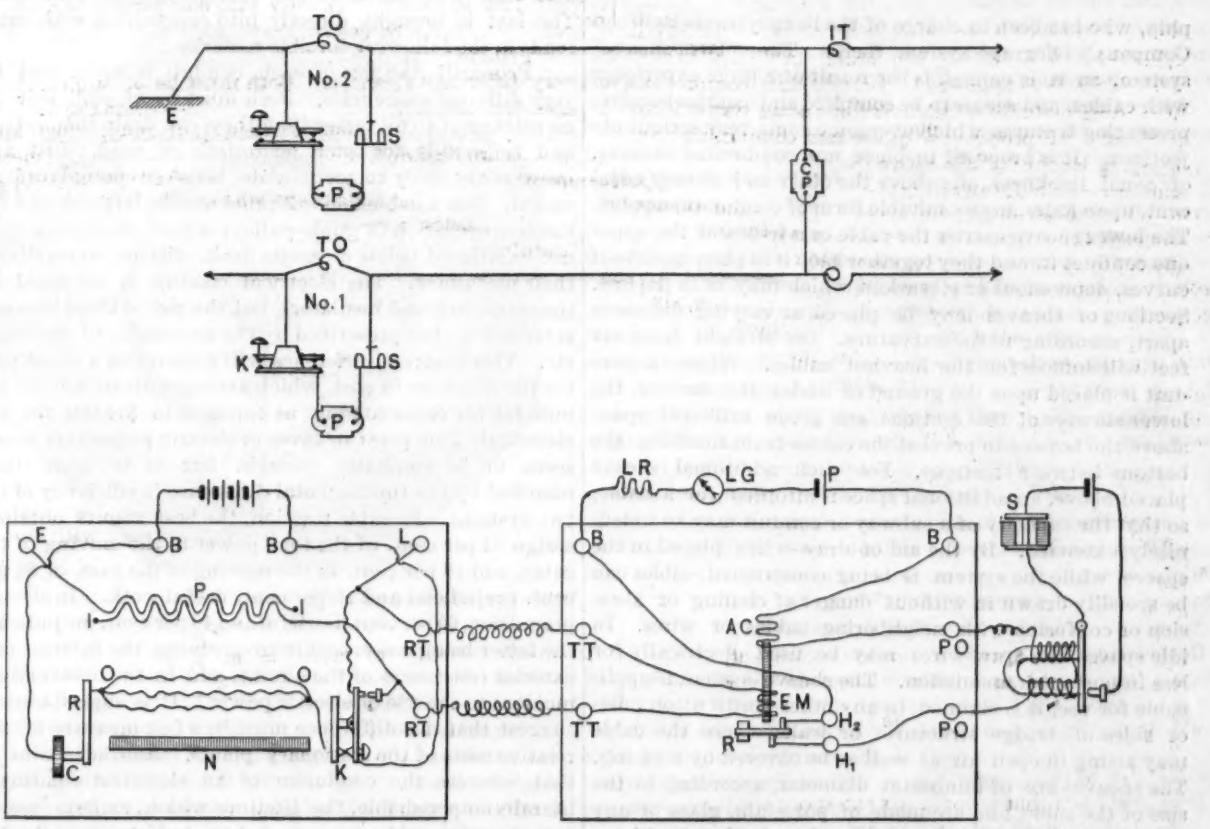
FIG. 6.—THE PHONOPORE RECEIVER.

circuit, whatever that instrument be, is actuated and gives out the message. The vibrating reed *R* has two contacts H_1, H_2, to make and break while vibrating, as will be seen by reference to the figure, and the contacts themselves are small hammer heads on springs in place of rigid contacts.

By this arrangement Mr. Davies can transmit comparatively feeble phonoporic impulses over a line, and cause them by re-enforcement to operate ordinary sounders and other telegraph apparatus.

The engraving, Fig. 5, represents the transmitter, *R* being the reed and *K* the Morse key. Fig. 6 shows the receiving apparatus. Here *R* is the relay; *G*, the galvanometer; *O*, the variable resistance; and *A* an auxiliary bobbin on the core, which actuates the vibrating reed.

With the apparatus just described, two Spagnoletti extra sensitive needle instruments were connected through a resistance of 2,000 ohms, and worked satisfactorily with a battery of sixteen Leclanché cells, while a phonoporic telegraph was worked simultaneously with them by a battery of four similar cells. On increasing the resistance



FIGS. 3 AND 4.—DIAGRAMS OF PHONOPORE CIRCUITS.

of the line to 25,000 ohms, the phonoporic telegraph still continues to send messages, while the single-needle telegraph refuses to operate. This demonstration shows how the vibratory currents overcome the resistance of a trying line.

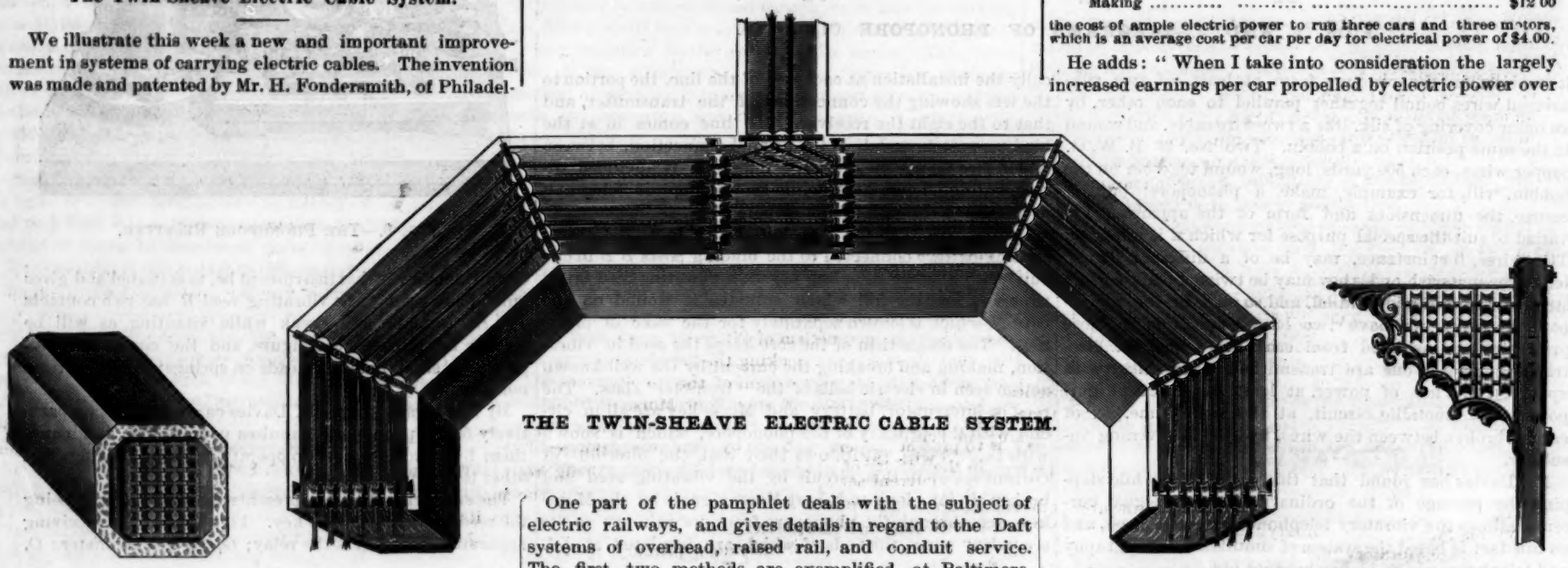
Another installation of Mr. Davies consists of a phonoporic telegraph on a line made up of twelve electro-magnets of a total resistance of 2,500 ohms, a quarter megohm (250,000 ohms), and an artificial line of 25,000 ohms, making a grand total of 277,500 ohms. The phonoporic telegraph operates through this and works an English post-office relay connected to a local sounder. Through the same resistance a phonopore telephone is also worked; the battery in this case being two Leclanché cells.

These experiments, as witnessed by *Engineering*, seem to show that the property of overcoming high resistance is possessed by comparatively feeble vibratory currents, a property which renders the phonopore capable of working on badly insulated and poorly conducting lines, when ordinary telegraph apparatus would fail. Moreover, besides its power of working simultaneously with an ordinary telegraph, or a telephone on the same wire, the phonoporic telegraph can be developed into a multiple telegraph by the well-known device of making the reeds vibrate to a particular note so as to send vibratory currents of one particular period. Several of these reeds, with their attendant transmitting and receiving apparatus, may therefore be used on one line, each sending its own particular vibratory impulses into the line; and these impulses would vibrate harmonic reeds at the other end of the line, thus working their own local receiver. In this way a number of independent phonoporic messages might be sent together on the same wire.

The Twin-Sheave Electric Cable System.

We illustrate this week a new and important improvement in systems of carrying electric cables. The invention was made and patented by Mr. H. Fondersmith, of Philadelphia, who has been in charge of the Pennsylvania Railroad Company's telegraph system there. The "twin-sheave" system, as it is named, is the result of a large experience with cables, and seems to be complete and comprehensive, presenting features which overcome some very serious objections. It is proposed to place non conducting sheaves, of equal thickness, one above the other and closely adjacent, upon axles, in any suitable form of conduit or support. The lower sheave carries the cable or wire, and the upper one confines it, and they together keep it in place in spite of curves, depressions or elevations which may be in the line. Sections of sheaves may be placed at varying distances apart, according to the curvature. On straight lines, six feet will suffice for the heaviest cables. Where a conduit is placed upon the ground or under the surface, the lower sheaves of the sections are given sufficient space above the bottom to prevent the cables from touching the bottom between sections. For each additional sheave placed above, an additional space is afforded for a cable, so that the capacity of a subway or conduit may be indefinitely extended. By the aid of draw-wires placed in the spaces, while the system is being constructed, cables can be speedily drawn in without danger of chafing or abrasion or confusion with neighboring cables or wires. In idle spaces, the draw-wires may be used electrically for less important transmission. The sheave system is applicable for use, it is claimed, in any other position; on poles or sides of bridge structures or walls where the cable may swing in open air as well as be covered by a casing. The sheaves are of minimum diameter, according to the size of the cable, and are made of porcelain, glass or any other insulating material, and the axles of galvanized iron. The Pennsylvania Railroad are using hardwood sheaves, and perfect facility and durability is found with them. The addition of the sheaves in any form of conduit adds comparatively small cost, it is said, in view of the advantages to be gained. The system can be introduced into the asphalt conduit by casting the conduit with a single large square opening and placing an iron frame containing sections of sheaves in position as the sides of the conduit are formed, spacing the sections according to the curvature and weight and variety of cables to be used. Branch conduits or right angle turns are made by placing the axles vertically at the turning point of the conduit.

Absence of abrasion, and confusion with other cables, perfect drainage, high insulation, perfect facility for drawing in and out, are the leading features claimed for the system.



THE TWIN-SHEAVE ELECTRIC CABLE SYSTEM.

The Daft Motors and the Electric Railway at Baltimore.

In view of the great interest taken in the electrical transmission of power, the publication by the Daft Electric Light Company of a large new pamphlet descriptive and illustrative of its motor system is very timely. The pamphlet discusses ably the various questions of safety, cost, revenue and the like, and touches on a variety of unfamiliar points. One of these is the extent to which a power station can overlet its capacity. The question has lately been discussed in these columns, and the following passage, supporting some of the statements made, will be found pertinent: "It was surmised from the start that a curious feature would appear in the use of distributed electric power, and experience has but served to place the anticipation far below the realization. Some electrical power plants now in operation are letting to their patrons very much more power than they are producing, and this without any delay or failure to meet every demand upon them. The Boston company *has let more than double the power it generates*, is still increasing its distribution, and will continue to do so until some indication is given of the limit of capacity being approached." A number of very warm testimonials at the end of the pamphlet, from customers, show that satisfaction has been given alike in Boston and in New York.

One part of the pamphlet deals with the subject of electric railways, and gives details in regard to the Daft systems of overhead, raised rail, and conduit service. The first two methods are exemplified at Baltimore. The last is brought directly into comparison with cable roads in the following forcible remarks:

"Primarily, the size of each conduit is prescribed by very different exigencies. Both must be of sufficient dimensions not to fill faster than they can drain themselves, and to provide for such accretions of mud, dust and snow as are likely to accumulate between periods of removal. But a cable conduit must also be large enough for the free operation of guide-pulleys whose diameters may not be reduced below a certain limit without neutralizing their usefulness. The electrical conduit is occupied by the conductor and insulators, but the size of these imposed is far below that prescribed by the necessities of drainage, etc. This inherent difference will account in a great part for the disparity in cost, which averages about $26,000 per mile for the cable conduit, as opposed to $14,000 for the electrical. This point in favor of electric propulsion would seem to be emphatic enough, but it is more than matched by the fundamental difference in efficiency of the two systems. In cable traction, the best results obtained assign 84 per cent. of the total power to the moving of the cable, and 16 per cent. to the moving of the cars, or 84 per cent. prejudicial and 16 per cent. useful work. In electric propulsion, 60 per cent. is useful and 40 per cent. prejudicial, the latter being consumed in overcoming the interior and exterior resistances of the circuit, and in the conversions incident to the use of electric power. It is superfluous to suggest that this difference must be a fair measure of the relative costs of the stationary plants. Another point is, that whereas the conductor of an electrical conduit is literally imperishable, the lifetime which experts assign to a traction cable is one and a half years. At the published price of $2,000 per mile, it is clear that the charge upon revenue to create a renewal fund for this object cannot fail to be a burdensome and oppressive tax."

Touching the Baltimore road, a report is given, of so recent a date as September 25, from Mr. T. C. Robbins, general manager of the system of which the line is part. He says: "Its success by the change from horse and mule power to electric power under the Daft system has exceeded my highest expectations. It has largely increased travel on the route, and at a less operating expense than horse power. The road has been running more than a year by electricity with as much regularity as any road in the country. I find less difficulty in getting men to run the motors properly than I do to get men to run the ordinary horse car properly. The road is now being run by persons who, before their employment here, were unfamiliar with electrical affairs. The overhead conductors that have been lately put up to carry the current overhead at the road crossings are working very successfully. We are now extending the overhead conductor over another branch of the road, which we expect will be completed before many weeks." He then gives the subjoined figures:

For the year ending Sept. 1, 1886, the road carried, with two cars propelled by Daft electric motors, 311,141 passengers at 5 cents each	$15,557.05
For the corresponding year ending Sept. 1, 1885, the road earned, with three cars propelled by horses, 227,155 passengers at 5 cents each	11,357.75
Showing an increased gross earning by two electric cars of over the gross earnings of three horse cars for corresponding time the previous year.	$4,199.30
The average number of passengers carried per car per annum by electric power was	155,570
The average number of passengers carried per car per annum by horse power was	75,718
Showing an excess of passengers carried per car per annum by electric power of over horse power per car per annum	79,852
The average gross earnings per car per annum propelled by electric power was	$7,778.52
Average gross earnings per car per annum by horse power was	2,785.91
Showing an excess of gross earnings per car per annum of in favor of electric power per car per annum over horse power per car per annum.	$3,992.61
The average cost of horse power per car per day is $6.50. The cost of the electric power per day on this road is:	
1½ tons of coal, at $3.50 per ton	$5.25
An engineer at	2.00
A fireman at	1.50
Oil and waste	0 50
Interest and depreciation of plant	2 75
Making	$12 00

the cost of ample electric power to run three cars and three motors, which is an average cost per car per day for electrical power of $4.00.

He adds: "When I take into consideration the largely increased earnings per car propelled by electric power over the earnings per car propelled by horse power, I am very favorably impressed with the large percentage shown in favor of electric power over horse power for propelling street cars. There is not two miles of street railroad in the country more difficult to operate owing to the unprecedented grades and curves to overcome than the two miles that are being successfully operated here now by electricity. There is not 300 feet of level track at any one point on the road. The grades vary from nothing to 350 feet to the mile, with curves from 40 to 70 feet radius on heavy grades. With more favorable conditions, such as cheaper fuel, easier grades and curves, a much more favorable result could be obtained than on this road."

There can be no doubt as to the fact that the cost of fuel in this instance is far too high, but aside from that, the success of the road shows how easily and profitably electric power can be applied to almost every one of the street railways in this country.

A Misleading Paragraph on "Telegraphic Frauds."

Considerable comment and inquiry was aroused in this city on the 11th inst. by the publication of the following in the papers of that day:

"London, Oct. 10.—In last week's issue of the *Electrician* there appeared a paragraph saying that the local officials of the Anglo-American (Western Union) Cable Company had been accused of tampering with stock messages, thereby fraudulently obtaining large sums of money. The officials of the cable company were very indignant over the publication, and insisted that an apology be made in the *Times* and other leading papers.

"No apology was published in the *Times* or any other of the great newspapers, but the *Electrician* this week explains that the offensive paragraph did not refer to cable operators, and also says that the article was reprinted from the New York Electrical World, which journal had copied it from the Minneapolis *Tribune*, the alleged culprits being Minneapolis operators. The *Electrician* expressed itself as deeply regretting the muddle, but maintained that the paragraph published was a fair abstract of the original article.

"The cable company's officers insist that an ampler and more widespread apology be made, and threaten that otherwise the leading members of their staff will bring individual actions against the *Electrician* for libel."

The London *Electrician* of Oct. 1 was delivered in New York on the same day that the above paragraph was published, and was found to contain the following:

"TELEGRAPHIC FRAUDS.—Serious accusations are brought against certain of the local officials of the Western Union Cable lines as to systematic tampering with or delaying Stock Exchange messages, whereby it is believed that large sums have been fraudulently obtained."

We have naturally endeavored to ascertain in what manner the mistake had arisen. Subjoined is the item on which the *Electrician* based its paragraph. It appeared in our columns under "The Telegraph" on Sept. 18:

"DISHONEST OPERATORS.—The Minneapolis *Tribune* makes some very damaging accusations relative to the methods employed by Western Union telegraph officials to fleece grain brokers of the cities of Minneapolis, St. Paul and Duluth. It appears from these statements that operators, in some instance with the connivance of office managers, have systematically manipulated market quotations in the interest of cliques composed of themselves and other dishonest traders. This is claimed to have been accomplished by withholding messages, giving changes in the quotations in the Chicago markets until deals could be placed for themselves with brokers in the cities mentioned. Then the new quotations would be sent out and these dishonest deals immediately closed. There has been common complaint for several months that quotations have been repeatedly held back in the St. Paul office, often for a quarter of an hour after important changes had been noted over private wires. So far as reported, no very large sums have been made at any one time, but, the system having been in operation so long, the aggregate earnings should be considerable."

It will be seen from this that our authority is quoted, and that there is not the slightest reference to cable lines or to stock exchange messages. We cannot imagine how our London contemporary came to condense the item in the way shown, as there is a distinct reference to the withholding of Chicago *grain* quotations. We deemed the charge too grave to be passed over in silence, and therefore gave it, with the authority; and so far the only contradiction, if such it can regarded, is the round-about one from London, given below, in the following editorial,

FIG. 1.—NEW MAGNETO CALL-BELL.

which we have by special Mackay-Bennett cable, from the *Electrician* of Oct. 8:

"TELEGRAPHIC FRAUDS."

"Under this heading we last week published a paragraph with reference to accusations seriously reflecting on the local officials of the Western Union Telegraph Company. Our authority was the AMERICAN ELECTRICAL WORLD which again had the statement from an American contemporary. We omitted to give our authority for this piece of gossip, a circumstance rendered the more unfortunate by the accidental insertion of the word "cable" in our description of the lines. The representative of the Western Union Company on this side of the water, the lessees of the American Cable Company, positively assures us there is no foundation for the statement, and, of course, there never was any as against the Cable Company. We gladly accept this assurance, and hasten to express our sincere regret at having inadvertently given pain and annoyance by publishing the paragraph in that misleading form. The wording complained of was in fact due to a mere blunder, the writer of the abstract failing to observe that "local officers" might be construed as referring to any person or persons in this country. We give prominence to this explanation in order that no effort on our part may be spared to correct the erroneous impression which is said to have arisen from our note."

No later information is forthcoming as to the action of the officials threatening libel suits.

Fluorine by Electrolysis.

M. Moisson has contributed to the Académie des Sciences a further note upon his recent discovery of a method of obtaining fluorine by electrolysis. His later experiments tend to add further confirmation of the fact that the gas which is obtained by this process is the element itself, and not a hydrogen fluoride, as was at first thought possible. By mixing fluoric acid with potassic fluoride, which greatly increases its conductibility, and also by surrounding it with a freezing mixture capable of reducing the temperature to — 50° C., M. Moisson is now able to obtain the separation of the gas with an electromotive force of only 10 Bunsen cells. The liquid is placed in a platinum capsule, which serves as one of the electrodes, and the other pole is formed by a platinum wire, which dips into the liquid. Unless the temperature be kept very low, the platinum is attacked with rapidity by the liberated gas.

A New Magneto Call-Bell.

Among the novelties manufactured by the recently organized Waterbury Electric Company is a magneto call-bell which possesses several interesting features and which can easily be applied to the ordinary telephone circuits. The engravings, Figs. 1 and 2, show the magneto respectively with the door closed and open. The magnets, as will be seen, are circular in shape and consist of four annular steel rings bolted together and having pole-pieces between which the armature revolves. The ringer consists of an electro-magnet to which is hinged a soft iron armature bent twice at right angles so that its ends come opposite the ends of the core of the bobbin. A permanent

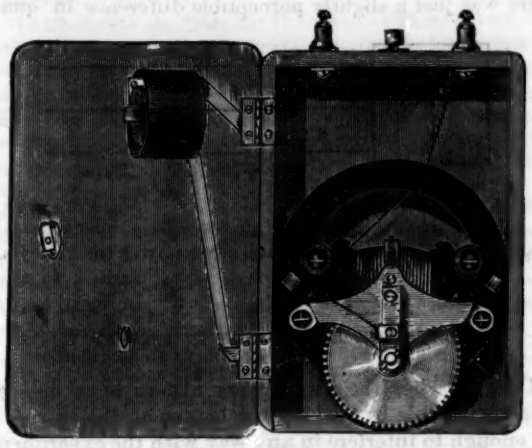


FIG. 2.—INTERIOR OF MAGNETO CALL-BOX.

steel magnet bent in the shape of a circle polarizes the armature so that the changing polarity of the electro-magnet caused by the alternating current generated by the magneto alternately attracts and repels the adjacent ends of the armature and so operates the ringer.

Means are also provided by which, when the magneto is not being used, it is cut out of circuit. The turning of the handle breaks the short circuit around the coils, and upon its release re-establishes the connection so that the articulation is not interfered with by useless resistance in the circuit.

The arrangement is neatly gotten up and is very simply constructed.

The Tabony Time Register.

The urgent demand that is felt for a good method of "watching the watchman"—in other words, of controlling and supervising men whose duty at night, or during the day, is to protect property and life by regular inspection—is seen in the variety of apparatus that has been designed for this purpose. A recent invention meriting notice in this line is the "time register" of Mr. J. H. Tabony, who, with a very intelligent comprehension of the problems involved, has sought to adapt any ordinary clock to the

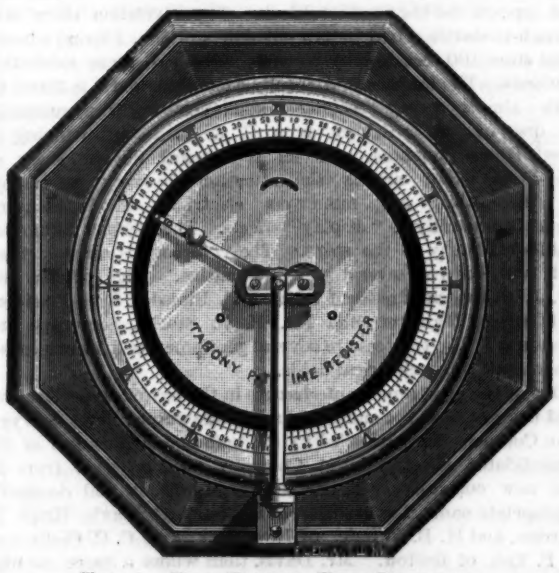


FIG. 1.—THE TABONY TIME REGISTER.

work, and by an ingenious attachment to convert it into an efficient register and detector. Mr. Tabony's device, however, goes much further than this, and is designed for a much wider range of utility. As before stated, any clock can be readily converted into a register. In addition, a bell may be placed in circuit so that every mark made is accompanied by an audible signal. Mr. Tabony ought to have no difficulty in introducing this device, for which, evidently, a variety of new uses may be found, such, for instance, as recording the time in races, checking the length of time occupied on any given work, reporting the vigilance of the "watch" on board ship, and so forth.

Our illustration, Fig. 1, shows the clock, which may be the timepiece of usual construction. Attached to the lower side of the face is a projecting arm that reaches to the centre of the dial and carries a pair of electro-magnets.

Both hands of the clock are removed and the hour hand is replaced by an arrangement shown in detail in Fig. 2. In addition there is applied to the dial a ring made of the so-called "silicate-slate," upon which the register marks are recorded in the manner described below.

The attachment to the spindle of the hour hand *B*, as will be seen, consists of a pointer which carries a lever *L*, pivoted at the centre. The inner end of the lever carries a short cylinder of soft iron *A*, which comes directly under the electro-magnets *M*. At its outer end it carries a thin piece of chalk or slate pencil *C*, which is held by a bent spring and rests against the ring (shown in section) of silicate-slate *D*. Throughout the watchman's rounds are placed push buttons connected with the magnets *M*, and with a battery in circuit. Whenever a button is pressed, the magnets are energized and attract the armature *A*, which is normally drawn away by the spring *S*. This movement of the lever *L* causes its outer end to be depressed, and the chalk upon the spring finger is pressed outward and leaves a short, straight radial mark. As soon as the push-button is released, the spring *S* draws the armature away from the magnets, and the chalk resumes its original position. As the pencil takes the place of the hour hand, it is evident that every mark indicates a definite time, and in this way an exact record is kept.

When the proprietor, or officer in charge, has inspected the marks and satisfied himself of the correct performance of the man on duty, the pencil or chalk marks can be wiped away with a damp cloth, so as to leave the ring clear for another record.

An "All-Round" Battery.

The October number of the Madeira *Monthly Correspondent* contains the following: "A want has lately been felt of a good 'all-round' battery; one, not only of the *constant* type, but one which will work equally well—(1) On cable circuits; (2) On land lines; (3) On house electric bells and annunciators; (4) As an exciter for recorder vibrators; (5) As a testing battery. With this end in view, we have lately thoroughly tested and have now in constant use on a cable circuit a battery of modified gravity cells of a form suggested by one of M. Hospitalier's books. Circumstances, however, have compelled us to adopt a slight modification, as to form and shape, from the drawing given in the book of the eminent French electrician. Our cell is as follows: The + pole is a piece of *lead* piping filled with sulphate of copper and slit at the bottom, the slit pieces being opened out so that the lead piping

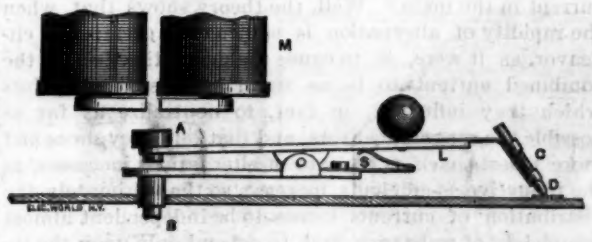


FIG. 2.—DETAILS OF TABONY TIME REGISTER.

stands up easily in the centre of cell. Unfortunately, we have to utilize the old Minotto jars, which are of the roughest make, and some of which are not even straight, and with bottoms all on one side, owing to bad manipulation of glass. The edge of the glass jar supports the out-reaching lappets of the — pole, a massive ring of *zinc*, through which the lead piping freely passes. We are having all our old refuse zinc recast into zincs of the above form, and all useless old Minotto coppers are replaced by this cheap substitute, lead-piping, which answers very well. Charged with a weak solution of sulphate of zinc, the above battery is about 3 ohms per cell, but after working for two or three weeks, falls to 2 ohms per cell, at which resistance it remains. If one sets up the battery by filling up with water, and short-circuiting for a short time, the battery is at first about 17 ohms, and then, as the sulphate of zinc is formed, gradually falls to 2 ohms per cell. When the cell requires more sulphate of copper, a little is dropped into the lead piping. We had a battery of these cells on closed circuit for a week, and every morning rough tests for R and E. M. F. were applied; its behavior was perfect."

An Amateur Dynamo Builder.

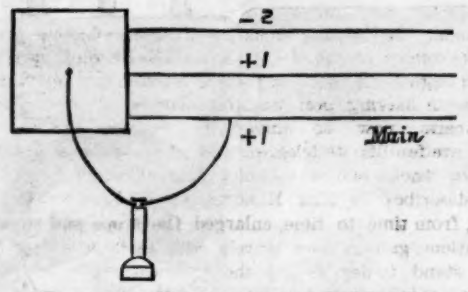
To the Editor of The Electrical World:

SIR: I am a young man, twenty years of age, at present engaged in telegraphing. Ever since I was quite small I have been deeply interested in the science of electricity, studying and experimenting as my circumstances would permit, but which has been rather limited because I live in a small country town. I have considerable mechanical ingenuity, and have been able with my small lathe, drill press and other tools to make almost any kind of electrical instrument I desired to. My ambition for some time has been to make a dynamo large enough to run about 25 incandescent lamps of 16 c. p. Now I would like to correspond with some one who has had some experience in this kind of work who would be willing to help me along. If there be such person, either professional or amateur, who will signify his willingness to correspond by dropping me a few lines through the office of your paper, I will always be grateful. AMATEUR ELECTRICIAN.

On an Experiment Showing that a Divided Electric Current may be Greater in both Branches than in the Main.*

BY LORD RAYLEIGH.

This is perhaps a somewhat paradoxical title, but I thought by so describing the experiment I might, perhaps, bring out the real point involved in it. The question is, how do conductors in multiple arc, or in parallel, behave when subjected to alternating or periodic currents? The paradox is involved in the silent introduction of the idea that the currents are steady. If they are intermittent there is no reason for supposing that the current in the main is the arithmetical sum of the currents in the branches. It must be the algebraical sum under all circumstances. The question of the behavior of two conductors in parallel is a very easy one, if we suppose the currents to be steady. We have then the ordinary and familiar law of the division of the current between the two in proportion to their conductivities; but if the currents are alternating, and if the conductors placed in parallel have the property of self-induction, which they must have in some degree, and still more if they have a sensible mutual induction one upon the other, then the case becomes very much more complicated. In a paper I published a few months ago in the *Philosophical Magazine*, I gave a general calculation of what the resultant resistance of the two conductors placed in parallel to alternating currents would be, and also what the resultant self-induction of the two would be. That is to say, I gave what would be the self-induction of any single conductor. In examining that closely I saw what appeared to be very curious things involved in it, and things which would be brought out supposing the two currents placed in parallel were composed of wires led side by side so as to travel very nearly along the same course, and I think I shall perhaps best explain what I have to say by limiting myself to that. Suppose that you have three wires led side by side together and made into a coil of a considerable number of convolutions, and suppose that you take two of those wires in series, and combine them in such a fashion that the current will circulate in the same way round both of those, and take that as one of the conductors in parallel, and as the other conductor in parallel take the third wire, and then submit the system composed of those three wires forming two conductors in parallel to alternating currents, what will be the condition of the currents between the two conducters there, and how will they be related to the current in the main? Well, the theory shows that when the rapidity of alternation is sufficiently great, the endeavor, as it were, is to cause the magnetic effect of the combined currents to be as small as possible at points which they influence, in fact, to neutralize as far as possible the magnetic effects, and that tendency more and more asserts itself as the rate of alternations increases, as the inductive co-efficients increase, so that ultimately the distribution of currents comes to be independent almost completely of resistance, and to depend only upon the induction co-efficients. And in this peculiar case, as you may see at once, the energy of the field of magnetization at various points not quite in the immediate neighborhood of the three wires may be, in the distribution of the current, neutralized, because we have only to suppose that the current of the two wires joined in series is just half that, and in the opposite direction to that in the single wire in order to have at all points complete neutralization of effect; so that under the influence of rapid periodic currents this is the state of things. But as you see, what is involved in that is this: The current in the one conductor, in the two wires placed in series, should be represented by + 1, the current in the single wire by — 2, and the current in the main by + 1, numerically less than one of the currents in the branches. This is perhaps the easiest form in which to make the experiment. It so happened that I had a large coil triply wound, and I tried the experiment in the form in which I have related it. In order to estimate the currents in the three conductors I adopted the plan of having a piece of copper sheeting fastened to a board and three German silver wires fastened to it. The current was tested by a process in which the telephone was used. Another wire was soldered to the copper sheeting and went to one pole of the telephone, and the German silver wires were connected by touching at various points, so that if the currents had been equal in those three wires the sounds produced by touching at the second telephone terminal would have appeared equal. It was found at once that the current in one of the branches was very much stronger than the current in the other branch, and more than equal to that in the main. Knowing what one wants, it would perhaps not do to trust to one's self, still by putting an assistant at the telephone, and by trying various places, it is possible to feel out the quality of the current so as to get something like a numerical estimate of it in this way. But I was not quite satisfied with that. I have said in my title, greater in both branches than in the main. I have arranged something else, but the principle is just the same. It involved iron, and it is most easily understood by having five wires instead of three. I combine them so that three are in series and two are in series; but the three in series are to be combined in parallel with the other two in series, so that in that way, in order to get neutralization of magnetic effect at a distance, it is necessary that the currents in the two branches in parallel must be in the opposite proportion taken negatively. The currents must be in the proportion of + 3 and — 2. That is the state of things; consequently both are numerically greater than the current in the main, which is + 1. I have verified it sufficiently to show that there is no difficulty whatever in so arranging the thing that the currents in both branches are decidedly greater than that in the main. Perhaps I might just say for the information of anybody who may wish to repeat the experiment, that it is a very easy one indeed, if you have a suitable coil to work upon. I used a scraping contact only, a battery and scraping contact to give the sound of the induction of the telephone. There was just a slightly perceptible difference in quality



RAYLEIGH EXPERIMENT IN INDUCTION

and degree when the sounds were caused to be as nearly equal as possible by varying the length of the wires, but not enough to interfere in any way with the experiment.

* Read at the British Association Meeting.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, Oct. 11, 1886.

Hawthorn & Frisbie, the New York agents for the Shipman engine, dissolved partnership last month, and on Oct. 1 the new firm of Hawthorn & Carr began business as selling agents for the engine, at 12 Cortlandt street. Mr. Lowell H. Carr was actively employed with the old firm, and was instrumental in the disposal of a great many engines, especially among those interested in electrical pursuits and applications—for example, Mr. C. D. P. Gibson, in his laboratory, for the manufacture of accumulators; Mr. Stephen D. Field, in his laboratory at Yonkers, for running the dynamo in connection with his new sextuplex; Dr. Henry V. Parselle, for electric lighting at his residence, East 20th street, this city. Mr. D. G. Hawthorn is also well-known to the electrical community. There is no reason why these energetic and enterprising young men should not find success crowning their efforts. The engine they represent has now stood a severe test in electric lighting for plants of a capacity up to 4 h. p., and it has been equal to the demands in every other department. The handy combination of boiler and engine in small compass on one base, and the use of oil as fuel, adapt it to a great variety of requirements.

The Empire City Electric Company has been organized very quietly in this city, and though it takes something to upset the equanimity of an old newspaper man, I must confess I was somewhat surprised when Mr. J. H. Blaisdell, meeting me on Broadway last week, buttonholed me and led me into 779 Broadway, just opposite the big Stewart block. The revelation there was enough to startle a Red Indian out of his stoicism. I found a handsome store 100 feet deep by 25 wide, with two large exhibition windows. The interior is tastefully decorated, and it is fitted up with almost every electrical appliance worth mentioning. In one of the windows is a C. & C. motor running a New Home machine, and as is natural, the efficiency of the little motor arrests the attention of every passer by. In the other are numerous electrical goods lending themselves readily to "display" effects. The electric light will add its brilliancy to the store. The company is already busy and will control several new specialties. The officers are Mr. J. C. Gulick, President; Mr. J. H. Blaisdell, Vice-President and General Manager; and Mr. H. L. Storke, Secretary and Treasurer. The trustees are several gentlemen well known in telephone and other electrical fields.

One of the most important changes in the incandescent lighting field has just been consummated and made public. The Sawyer-Man Company has succeeded to the commercial business of the Consolidated Electric Light Company, under license from it. The new company, with its highly-significant and decidedly appropriate name, has as directors: Henry C. Davis, Hugh R. Garden, and H. B. Putney, of New York, and C. C. Coffin and F. P. Fisk, of Boston. Mr. Davis, than whom a more popular man cannot be found in electrical circles, is president and treasurer. The New York offices of the new organization will be at the Mutual Life Building, Nassau street; the Philadelphia offices at 205 Walnut place, and the Boston offices at 33 Federal street. The company has put its hand on some very able and efficient men, to whom is intrusted the responsibility of carrying on its operations, and it is ready to furnish plans and estimates for all kinds of incandescent lighting. It also undertakes to make estimates for the Thomson-Houston arc system. Altogether, the auspices are very favorable, and I shall be greatly surprised if the company does not make a good mark and enjoy a large share of patronage.

Mr. Harry Miner has just finished a beautiful new theatre at Newark, N. J., and with his usual enterprise and judgment he has put in the electric light. The massive chandelier which hangs in the lofty dome of the theatre is one of the main ornaments of the house. It was built by I. P. Frink, of this city, and cost Mr. Miner $1,500. It measures thirty feet from the brass ball at the end of the stem to the plate, at the upper extremity of the stem, and weighs 800 pounds. It contains 262 lights, gas and electric. The gas burners are made to resemble candles. The electric lights are incandescent lamps. It is proposed to light the house by electricity, the gas being reserved for supplementary purposes in any very special illumination. The lights can be used finely for scenic display, as many effects can be obtained by colored combinations. The lower circle contains fifty-six gas and fifty-six electric lights. It is surmounted by a silvered glass reflector. The gas will be lighted by electricity, three wires connecting with lights at equal distances from each other in the circle. Above this circle and the reflector are ten clusters of lights, each made up of six gas burners surrounding three electric lamps. Six feet above this circle of clusters is still another of ten clusters, each made up of four gas lights surrounding two electric lights. The chandelier is richly ornamented with brass, and the stem and pipes are silvered over or bronzed. The wide band running around the reflectors is painted red. The chandelier can be raised and lowered at will. In addition to this chandelier numerous side lights, both gas and electric, are in the theatre.

The fair of the American Institute is now getting into pretty good shape. Electricity and its accessories do not play as important a part as one might expect, but there are a good many exhibits interesting to electricians, and I think the number will yet be increased. The Kidder Company and the Galvano-Faradic Company have fine exhibits of medical apparatus, and I understand that Waite & Bartlett will put in an appearance in the same line. The building is lighted by the United States system, and there are Ball and Clarke dynamos also in operation. I believe some motors are to be shown running on various work. C. A. Schieren & Co. show some of their belting, as also do Fayerweather & Ladew some of theirs. Mr. A. B. Laurence has some Underwood belting there too. A little later, when the exhibits are more numerous and complete I shall be able to make fuller notes. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Oct. 11, 1886.

The Bernstein Electric Light Manufacturing Company is preparing a circular for distribution among the electric lighting interests.

The Chelsea, Mass., Electric Lighting Company has nearly doubled the lighting capacity of its plant since the beginning of the year.

The Redding Electrical Company, of Boston, contemplates entering the electric light field at an early day, with a new system of incandescent lighting.

The Synchronous Time Company, with headquarters in this city, is entitled to congratulations for having been successful in its undertakings from the very commencement of operations with its new and meritorious system.

The Osborn Mills, Fall River, are rapidly changing over the Montaup Mills, lately bought by them. W. T. Henry, of Fall River, is the mill engineer in charge of the alterations. Among the contracts placed already are those for 72 deliveries of electric stop motion drawing frames, nine intermediate roving frames, 132 spindles, each with electric stop motion for prevention of "single," and one new model copper cylinder slasher. The above contracts were placed with Riley & Gray, of Boston, and all the machinery will be made by Howard & Bullough.

The Jarvis Engineering Company has contracts to set two tubular boilers with the Jarvis furnace, from the Cambridge Electric Light Company, Cambridgeport, Mass. It has also sold the company Sheffield grate bars, to burn screenings and fine coke for fuel. It has also secured contract to enlarge the station of the Woonsocket Electric Light Company, Woonsocket, R. I., setting a new tubular boiler and another Armington & Sims engine.

In purchasing a boiler, remarks a paper here, two things are specially needful—safety and economy of fuel. The patent triple draft tubular steam boiler, invented by Wm. A. Hennessy, and made by the R. F. Hawkins Iron Works, Springfield, Mass., would seem to possess both these requisites. The claims of the Hennessy boiler are briefly summed up as follows: Economy in absorbing the heat of the furnace combustion and ease in making steam. More heating surface of vital power is contained in less space than, and in as favorable shape as, any other boiler yet constructed. The added cylinder makes steam throughout its entire length. When the cheapness, durability, simplicity of construction and ease of access are considered, the value of the boiler is readily apparent. The number of these boilers in use is rapidly increasing and they give satisfaction wherever introduced.

The firm, composed of the young and enterprising electricians Messrs. H. E. Swift & Company, Attleboro, Mass., will hereafter be known as Messrs. Swift & Smith. Their factory, workshops, show-room and office are nearly opposite the passenger depot of the Boston & Providence Railroad. During the past twelve months the business of this firm has developed into such proportions that their present manufacturing facilities are about to be enlarged to enable the prompt filling of orders. The leading specialty among the manufactures of this firm is a varied line of electric gas-lighting keys, either nickel-plated or of fine wood. W. I. B.

PROVIDENCE, Oct. 5, 1886.

The Shipman Export Engine Company, formerly of this city, has transferred its officers to Boston, and may be found hereafter at No. 27 Court street.

Both electric companies of Providence having submitted very low estimates for lighting the Post-Office building with incandescent lights, the fact of the contract having been given to the gas company has created a good deal of unfavorable comment.

The Rhode Island Electric Lighting Company (Weston system), of this city, states that its business has never been on a more satisfactory basis than it is at the present time. Supt. John I. Drake reports, "We have now in actual use 190 arc-lights, 798 incandescents of 16 candle-power, and 120 'Moguls' of 125 candle power. Our lighting capacity is as follows: 220 arc-lights, 840 incandescents, and 144 'Moguls.' The equipment of our plant comprises one pair of Geo. H. Corliss engines, of 200 horse-power each; one Harris-Corliss engine of 80 horse-power; two steel tubular boilers of 125 horse-power each, and one Geo. H. Corliss horizontal boiler of 125 horse-power."

The Narragansett Electric Lighting Company (Thomson-Houston system), also of Providence, reports through its superintendent, Mr. V. A. Thomas, a very encouraging condition of its affairs. It was only a few months ago that the lighting capacity of this company's plant was nearly doubled, and now the number of

orders in hand for both arc and incandescent lights necessitates the addition of more dynamos to the equipment. The town of Johnson, a suburb of Providence, will probably be lighted at an early day by the Narragansett Electric Light Company, a proposition to furnish twelve lights at 50 cents each per night for one year having already been submitted to the Johnson authorities.

The Alarm Box Controller Company, of Providence, has issued to the public in general, and to manufacturers in particular, a very interesting little circular, giving a brief but comprehensive outline of the aims and objects of the new system which it is about to put on the market. The entire apparatus connected with this system is the invention of Mr. C. D. Rogers. The system is no longer an experiment, having been in successful practical operation over a year at the mammoth establishment of the American Screw Company, Providence, where nearly forty different rooms and buildings are connected with the "Gamewell" alarm box in the old "Eagle Mill"—thus enabling the watchman, in case of fire, wherever he may be, to ring in an instantaneous alarm on the whole fire telegraph system of the city. The new system, while in no way interfering with the fire-alarm telegraph, as now constructed, vastly increases its efficiency and value, it is claimed, by making each street box now in use a central station around which any number of buildings can be connected, so that from any of them the box can be instantly operated without going to it, by pressing an ordinary push button, the latter being properly protected by seals and keys, as the circumstances may require. The Alarm Box Controller Company is already arranging for the introduction of its system into some of the leading cities of the country. Mr. Charles E. Bailey is president of the company, and his address is No. 71 South Main street, Providence, R. I.

The Miller Iron Company, of Providence, one of the most successful manufacturing industries in Rhode Island, is having quite a heavy run on one of its specialties, namely, its patent grate bar, which is claimed to be one of the most durable in the market and eagerly sought after by manufacturers. It is said that a very large and wealthy electric lighting company in Rhode Island has decided to adopt the Miller bar. W. I. B.

NORWICH, Conn., Oct. 7, 1886.

Mr. George W. Fuller, identified with electrical enterprises many years ago in New York City, and who has numerous friends among the electrical fraternity, has settled down in this thrifty little city to engage in the manufacture of submarine apparatus and appliances adapted to modern submarine engineering.

The Norwich Gas Company has purchased a controlling interest in the Norwich Electric Light Company, the change taking effect the first day of this month. This places the latter company on a splendid financial basis, it now being not only out of debt, with a profitable and steadily increasing business in hand, but also with the most encouraging prospects ahead. Mr. Geo. W. Phillips, the superintendent, said to me: "This company is at present running 55 arc lights and 237 incandescents (both systems being those of the Thomson-Houston), and orders are in hand for a large number of arcs and incandescents both for the city and for commercial use." Mr. Phillips has made an ingenious apparatus for muffling steam, which he has had in practical use in his company's plant for several months; and it has worked satisfactorily from the very day it was adopted. It is an ordinary box, 8 feet long, 4 feet high and 4 feet deep, into which the steam exhausts direct, with a two-foot outlet (funnel shaped) at the end of the box, which conducts the steam off. Mr. Phillips' inventive proclivities do not stop with the exhaust box, for he has just applied for a patent on a simple but valuable little machine for cutting off the jagged ends of dynamo brushes.

WILLIMANTIC, Oct. 8, 1886.

A local electric lighting company has just been organized here, and expects to have the equipment of the plant in such a shape as will admit of the lights being started up the first week in November. It is claimed that orders are already in hand for twenty-five arc lights for commercial use; and the assurance has already been received from the city authorities that a number of lights would be wanted "right away" for street lighting. The officers of the company are as follows: Edwin A. Buck, President; Henry F. Royce, Treasurer; with E. S. Boss, A. R. Morrison, and the two gentlemen above named as directors. W. I. B.

MIDDLETOWN, Conn., Oct. 9, 1886.

On my arrival in this lovely and enterprising town I had the pleasure of meeting Mr. G. D. Sturtevant, the electrician and traveling representative of the Crystal Carbon Company, Cleveland, O. The excellence of the carbons or the geniality of the gentlemanly agent—probably both combined—made such a favorable impression at the electric light plant here, that, notwithstanding the fact that an order for 40,000 carbons had recently been given to a competitor of Mr. Sturtevant's company, an additional order was given for a supply of the "Crystal" product.

The Middletown Schuyler Electric Light Company, although a young enterprise, deserves attention for the excellent management which has characterized its operations from the day its lights were started up. By a careful study of the wants and requirements of its patrons, it has steadily overcome the prejudice existing here last year against electric lighting, and to-day the company is furnishing 60 full arc lights and 95 divided arc lights, together with 240 incandescent lights (off arc-circuit) from four sets of distributors. The equipment of the plant comprises the following, viz.: two 30-light dynamos, two 45-light dynamos, and one 55-light dynamo, all of the Schuyler make. These derive their power from four Fitchburg engines—two of 75 h. p. and two of 90 h. p. Another circuit is now being added, which will increase the lighting capacity of the plant about 35 full arc-lights. The officers of the company are D. Ward Northrop, President; James P. Stow, Secretary, Treasurer and General Manager; P. H. Fielding, Electrician, and P. E. Lehey, Foreman. W. I. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, Oct. 9, 1886.

Out at the Pullman works, electric railways have lately given quite a little new work. The following orders have been in course of execution recently:

Scranton (Pa.) People St. Ry. Co., four 16-foot railway style, to be used with the Van Depoele electric motor cars to be lighted and signal bell operated by same system.

Highland Park W. R., Detroit, two 14-feet electric motors, built by Detroit Electrical Works, motor in centre of each car to occupy space of 24 inches square.

I hear that the Babcock & Wilcox Company have recently sold boilers of 127 h. p. to the Kansas City Electric Light Company.

The great packing-house strike here has led to an increased use of electric light. The freight business of the various railroads is almost at a standstill, and not more than half the usual number of engines are at work in the yards. Arrangements have been made to have all the alleyways and railroad tracks around the houses illuminated by electricity at night, and a gang of men are at work putting in the poles and arranging the wires and apparatus.

The Sheffield Velocipede Car Company, of Three Rivers, Mich., manufacturers of railway specialties, have issued their first trade catalogue. It is a sumptuous publication, reflecting great credit on the concern and on the printers. The Sheffield cars have long had a high reputation, and the company are naturally a little proud of having been the first makers of the three-wheeled hand-cars now so universally popular. Some of the cars are familiar to telegraph and other line men working along railway tracks, and have also, if I mistake not, been illustrated and described in THE ELECTRICAL WORLD. The company have, from time to time, enlarged the scope and area of their operations, gaining new laurels with each new departure, and they stand to-day among the foremost producers of railway specialties in their own field.

I notice the following recent incorporations in the West:

The U. S. Electrical Construction Company, Dubuque, Ia.; capital stock, $50,000; secretary, Edward T. Kein.

The Electric Manufacturing Company, Logan, Kan.; capital stock, $100,000. Howard Gove and others, incorporators.

At Wichita, Kan., the Riverside & Suburban Railroad Company has been incorporated to build a line from Wichita to Riverside, and to operate the same by steam or electric power. Directors: J. O. Davidson, William Innes, H. G. Lee, C. L. Davidson, and W. E. Stanley. Capital stock, $100,000. W. A. K.

THE TELEGRAPH.

French Cable Directorate.—A cable dispatch received in New York announces the election of a new directory for the French Cable Company.

France and Madagascar.—At the next session of the Chamber of Deputies M. Granet, Minister of Posts and Telegraphs, will introduce a bill providing for the laying of a cable connecting France and Madagascar.

Bankers and Merchants' Lines.—In this city on Oct. 5, Judge Potter, in the Supreme Court, gave a decision denying for the present the motion recently made on behalf of Edward S. Stokes, the purchaser under foreclosure of the property of the Bankers and Merchants' Telegraph Company covered by the mortgage of $10,000,000 held by the Farmers' Loan and Trust Company as trustees, to compel the latter corporation to turn over to him certain shares of stock of telegraph companies outside of this State, which had formed part of the assets of the Bankers and Merchants' Company. The judge denied the motion without prejudice.

THE TELEPHONE.

Long Island.—Telephonic intercommunication is being established between Flushing, Jamaica and Sayville.

A Belgian Exhibition.—It is stated that the Société Belge des Ingénieurs et Industriels, with 900 members, will hold at Brussels during January an exhibition of telephonic appliances and everything relating to telephony.

News from Cincinnati.—Reliable advices from Cincinnati of a late date to a Boston banking house state, relative to the suit now pending as to jurisdiction in that city, "that many of the attorneys of Cincinnati have frankly expressed their opinion that, if any attention is given to the law, the case must be decided in favor of the Bell Telephone Company, that there seems to be no divided opinion, and that a decision is expected this week." A communication from another source states "that there seems to be a decided change in the feeling in Cincinnati, in the direction that the Bell Company will win the suit on jurisdiction. It is said that Judge Jackson is antagonistic to the Pan party."

THE ELECTRIC LIGHT.

Norwalk, O.—The city council proposes to put in electric lights.

Reynoldsville, Pa.—An electric light plant will be put in the Hall & Vaughan tannery.

Ellsworth, Me.—The Ellsworth Electric Light Company has been organized, with a capital of $24,000. Mr. C. B. Story is President.

Nanticoke, Pa.—The Nanticoke Light Company has a capital stock of $25,000. The Treasurer of the company is Mr. E. G. George.

Brookline, Mass.—The Brookline Electric Light Company has paid a dividend of 1¼ per cent. for the quarter ending Sept. 30, on a capital of $30,000.

The New Edison Works.—A dispatch of Oct. 11 from Albany says: The Edison machine shops began operations to-day at Schenectady. They will employ 1,000 men when all the machinery is put up, and will manufacture all machinery used in electric lighting except lamps.

Zanesville, O., Electric Light Company has a capital of $25,000. It is using the Western Electric Company's system with great satisfaction. It now has 27 street and 27 private arcs in use. It is putting in two 70 h. p. Griffiths & Wedge engines with six 30-light dynamos, and by Nov. 1 will have about 70 private and 65 street lights running.

The Toledo, O., Asylum.—There has been considerable fighting over the contract for lighting the Toledo Asylum for the Insane. It was awarded to the United States Company, but the decision was objected to by the Brush, Edison and Westinghouse companies. The matter was argued on Oct. 2 before the Governor, the Attorney-General and the auditor of the State at Columbus, when these authorities decided against the validity of the contract made, and in favor of a re-advertising for bids.

Wires on the Elevated Track.—The Manhattan Railway Company has given the United States Illuminating Company notice to remove its wires from the railway structure at once. The lighting company does not propose to be "crowded," but is preparing to remove its wires as quickly as possible without detriment to its large business. One reason given for the action is that the structure is wanted for the Western Union wires, which are to run there to the exclusion of all others.

A Severe Test.—We are informed that on board H. M. S. Devastation a "Kapp" dynamo was recently kept running for twenty-six continuous days and nights without cessation, and at the end of that time appeared to be in as good condition as at the beginning. This was not undertaken by way of experiment, but simply because the light was required during the whole of the time to facilitate repairs. The result simply shows that with a thoroughly well designed dynamo there is no limit to the length of time during which the machine may be continuously run, except the eventual and inevitable wear and tear of the commutator.

APPLICATIONS OF POWER.

Port Huron, Mich.—The preparations for the new Van Depoele road are in such a state of forwardness that cars will in all probability be running this week.

The Dix Road at Detroit, equipped by the Van Depoele Company, is reported to be working nicely. The management has ordered another 25 h. p. motor for service at once.

Scranton, Pa.—The cars for the Van Depoele street railway at Scranton are now being built at Pullman, and the motors are in readiness to go on them. The road will shortly be in operation.

Looking at Motors.—It is stated on good authority that the Third Avenue street railroad company contemplates the use of electricity on its lines. The president of the company visited Baltimore this week to witness the working of the line there.

"Electricity as Applied to Railways."—Mr. G. W. Mansfield, of the Daft Company, will speak on Wednesday, the 27th inst., on the above subject, before the Electrical Section of the American Institute, at Clinton Hall. A very interesting evening is expected.

High Praise for Motors.—The users of Sprague motors in Boston are quite enthusiastic in their praise. A merchant tailor says: "I am more than pleased with the motor." The superintendent of the Bay State Cash Railway Company says: "It is the best and cheapest motor power I ever used." C. H. Farmer & Co., manufacturers of braid say: "It works better than steam with us, and we think it the best power for a small manufacturer." De L. Sheplie & Co., makers of straw goods, say: "We consider the motor a great benefit to us, in furnishing us with a uniform power.

An Electric Railway in the Pyrenees.—The electric railway, which is described in the following extract which we take from an article on the Lartigue single-rail system of railway lines in the current number of *Engineering*, would appear to be one of the most interesting applications of electricity which has been heard of for some time: "At the Ria Mines, Pyrénées Orientales, there is a very curious Lartigue railway, over which iron ore is carried for a distance of six and three-quarter miles. The line is worked by electricity, on a system designed by Messrs. Siemens, the full trains running down generating a current of electricity sufficiently powerful to haul the empty train up. The details of the system have not reached us, but probably they consist in using the motor on the descending train as a dynamo, which generates sufficient current to work the motor on the ascending train, the difference between the weights of the two trains being enough to compensate for the loss of electrical efficiency."

PERSONALS.

Mr. H. Kingsford, late electrician on board the steamship "Mackay-Bennett," and who a short time since accepted the position of engineer and electrician of the Central & South American Cable Company's system, has been very successful in repairing two of that company's cables—one repair having been effected in 36 hours. Mr. Kingsford is well known as a man of ability. He has written several papers on testing, and is certainly entitled to consider himself an expert in cable repairing.

Mr. William Henry Smith, of the Associated Press, sailed last week for New York from Liverpool, having been in Europe since early last summer. It is the first vacation Mr. Smith has taken for over eighteen years. He visited Scotland, Wales, Germany, and France, and in the latter two countries made arrangements for an increased and more efficient service of the Associated Press in Europe. This was especially needful in Germany, where the service has heretofore been entirely in favor of the Government to the detriment of accuracy of news.

MISCELLANEOUS NOTES.

Is Life Worth Living?—Somebody calling himself Dr. Andries estimates that "the peril from lightning is now from three to five fold greater than it was 50 years ago." Is life worth living or the earth worth keeping from the persons who want it? —*Chicago Times.*

Franklin Institute Lectures.—The Franklin Institute of Philadelphia announces an interesting course of lectures for its 1886-7 season. Among the lecturers and subjects, we notice: Nov. 19, Mr. E. A. Gieseler on "The Illumination of Maritime Coasts;" Feb. 11, Mr. Carl Hering, "Electricity: the Different Forms in which it Manifests Itself;" Feb. 18, "The Electrical Transmission of Energy;" Feb. 28, Mr. C. O. Mailloux, "The Storage of Electrical Energy."

An Electric Irishman.—A dispatch from Louisville of August 20 says: David Lindley is an old Irishmen who lives on Milk street. He is possessed of a singular affliction. About four years ago he was standing under a tree at Winter's Gap, East Tennessee, when a violent storm came up. The tree was struck

by lightning and felled to the ground. Lindley was rendered unconscious by the shock, but otherwise was uninjured. During every electrical storm since, he has experienced a peculiar tingling all over his body similar to that produced by an electrical battery. When the storm ceases the sensation leaves him, and is not again felt until another storm. Any person can receive a slight shock by catching hold of his hands during a storm. It is frequently tried by his neighbors, by whom he is considered a magnetic wonder. Mr. Lindley's health is in no wise impaired by the electricity, and he is of the opinion that it benefits him. Yesterday during the storm the shock was much greater than usual, and the effects have not entirely left him. He has a constant fear of lightning, and dreads the approach of a storm.

SPARKS AND FLASHES.

Good Advice from a Contemporary.—An English physician says that men shouldn't crop their hair short. Hair, he says, is a conductor of electricity to the brain, and if the brain fails to get electricity it will soon soften.—ELECTRICAL WORLD.

Let them cut their hair short and read the electrical journals.—*Progressive Age.*

And He Said Something Else, Too.—The Western Union Telegraph Company has asked for and received permission from the New York Subway Commission to maintain the wires already laid on the elevated railway structures. It claims that by thus stringing wires it had no intention of disobeying the laws. It galled Captain Corcoran, of the good ship "Pinafore," to be compelled to say "if you please" to his sailors; but he said it.—*Philadelphia Record.*

STOCK QUOTATIONS.

The following list, compiled by Mr. W. H. Baker, 16 and 18 Broad street, gives the current quotations of electrical stocks:

OCTOBER 12, 1886.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	40	42
Am. Tel. & Cable	73	76
Cen. & So. Am.	75	100
*Com. Tel.	.....	103¼
*Gold & Stock	.....	95
*Inter. Ocean Tel.	.....	95
N. Y. Mutual	60	70
Pac. & Atl.	45	55
*Postal T. & C.	15	25
South. & Atl.	65	75
W. U. Tel.	76¾	76⅞
W. U. Scrip.	64	65
W. U. Bonds	.....	126
Mut. U. Bonds	86¼	87
TELEPHONE.		
Am. Bell	213½	214
Am. Speaking	100	115
Erie	27½	28
*Hudson River	.....	55

TELEPHONE.	Bid.	Asked.
Mexican	1⅛	.....
*N. Y. & N. J.	75	80
N. Y. & Pa.	25	30
New England	41	41¼
*Southern Bell	100	130
ELECTRIC LIGHT.		
*Am. Electric	.....	16
*Brush	.....	.....
*Brush Ill	.....	.....
*Consolidated	.....	.....
*Daft	.....	100
*Edison	100	130
*Edison Ill	90	.....
*Edison Isolated	.....	.....
*United States	40	55
*U. S. Ill	50	55
MOTOR.		
*Daft	.....	.....
*Sprague	600	.....

* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

BUSINESS NOTICES.

Telephone cum Telegraph.—Applications for licenses for the use of the Black-Rosebrugh telephone system on "District" or other municipal telegraphs must be addressed to Banks Brothers, Church street, Toronto. Agents wanted.

A Sprague Motor Factory.—The Sprague Company has leased as a factory the Union Lead Works, a large building on West Thirtieth street, this city. Mr. Sprague expects to be turning out motors there inside of sixty days.

Magnetism in Watches.—

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, 216 *La Salle Street,*
Manager Western Department.

CHICAGO, Feb. 10, 1885.

Messrs. Giles, Bro. & Co.:

GENTLEMEN: I have now been carrying my watch encased in one of your Anti-Magnetic Shields for about a year, and it affords me pleasure to state to you that notwithstanding I have been very much about dynamo-electric machines during the time named, the anti-magnetic case seems to protect the watch perfectly from the magnetic influence of the machines. I have not made any special electrical tests, inasmuch as I regard the good running of the watch as all that is necessary. I am thoroughly convinced, from the effect upon my own watch, that the case is an excellent protection, and I may almost add an absolute preventive of magnetic influence from external sources to the delicate movements of a watch. My watch is a Howard watch, and during the period of two or three years previous to encasing it with your anti-magnetic case it had varied to a very great extent, and I had it demagnetized on two different occasions. I regard your case as a complete success, and if my indorsement of same is of any value, you are at liberty to use it.

Yours truly,

C. C. WARREN, *Manager Western Dept.,*
The U. S. Electric Lighting Co.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED SEPT. 28, 1886.

(1) 349,715. Electric Motor; (2) 349,716. Dynamo Electric Machine; E. T. Higham and Daniel Higham, Philadelphia, Pa., Assignors of one-third to J. M. Jones, same place. (1) The machine is composed of two electro-magnets of the Gramme type. The inner magnet revolves while the outer remains stationary, but both are provided with commutators. The current coming in, say at the brush *H*, will pass through the contact-wheel *F* to the commutator-plates with which they happen to be in contact, and thence through the corresponding conductors to the coils of both the electro-magnetic rings, there splitting and passing in opposite directions through opposite halves of each ring of coils and out through the contact-wheel *F'* and brush *H'*. Thus the traveling contacts rotate the polar points of both electro-magnetic rings in the same direction as that in which the rotary electro-magnet moves mechanically. (2) The construction is analogous to the former, but the object is to rotate the polar points of the armature and field-magnet in a contrary direction to that in which the rotary armature moves mechanically. See illustrations.

349,738. Car Brake; Harvey S. Park, Henderson, Ky. The invention relates to those car-brakes in which the momentum of the car itself is utilized for winding the brake-chains, electro-magnetic devices being employed for connecting the car-wheel axle with the brake-chain windlass at will for this purpose. Improvement on Patent No. 314,709, March 31, 1885.

(1) 349,739. Underground Conduit for Electrical Conductors; (2) 349,809. Coupling Device for Electrical Conductors; C. G. Perkins, New York, N. Y., Assignor to the Imperial Electric Light Company, same place. (1) The invention relates to a test-box for testing underground circuits and freeing them from moisture. The conductors are laid in pipes which can be exhausted by a pump, and thus any leak detected. (2) The invention relates to a novel method of coupling for incandescent lamp holders.

349,788. Insulator; N. T. Fitch, Chicago, Ill. The invention consists in imbedding a screw or other fastening device

349,788. INSULATOR.

within the body of insulating material, so as to form one complete fastening.

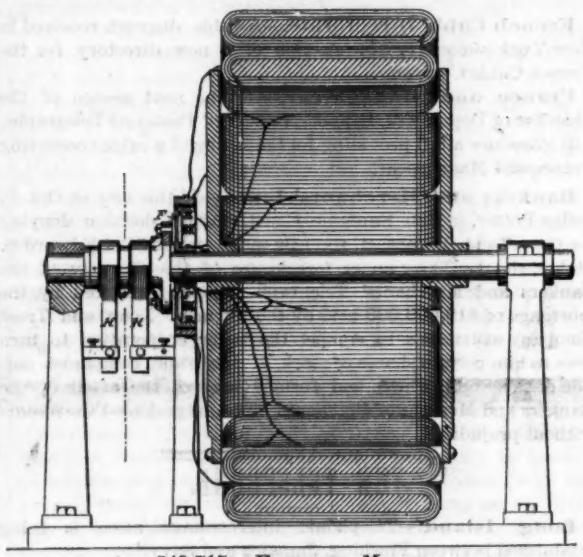
349,797. Electric Subway; J. W. Jagel, Brooklyn, N. Y. For description see THE ELECTRICAL WORLD, Jan. 23, 1886.

349,889. Tel phonic Apparatus; Patrick Gannon, No. 107 St. George's Road, County of Surrey, England. This is a return signal for the telephone described and illustrated in THE ELECTRICAL WORLD, Oct. 2, 1886.

349,879. Electric Clock; Domingo F. Garcia, Guadalajara, Mexico. This invention relates to certain improvements in clocks which are constructed with two toothed wheels on the same shaft, one of the wheels having one or more teeth more than the other, and both wheels being operated by the same pawl or pawls, whereby one wheel is moved faster than the other, and by means of scales, indicators, or hands on the wheels the relative positions of the same, and thus, also, the time, are indicated. The invention also relates to certain improvements whereby the clock is operated by electricity.

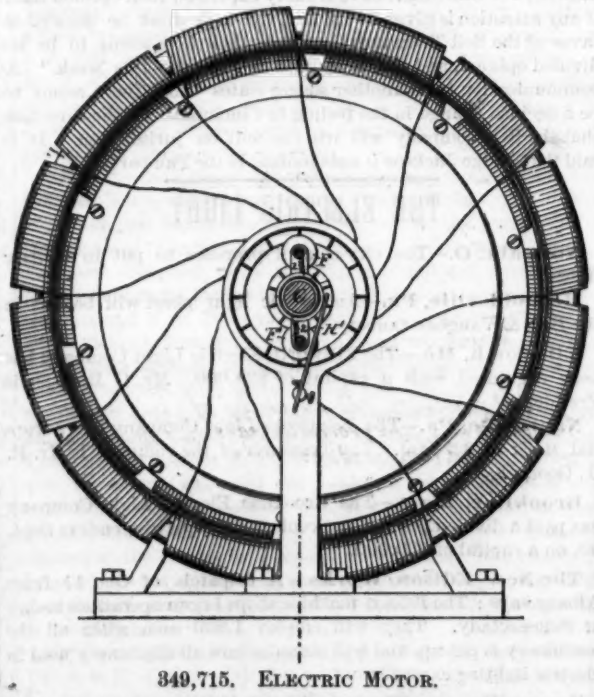
349,893. Insulator for Electrical Conductors; S. F. McGill, Keene, N. H. The invention consists in an insulation formed of sheet insulating material—such as rubber—bent into reverse pockets and supported in form for use by spring-clasps, made of wood—such as hickory—placed at short intervals in the length of the insulator. The whole is then covered with waterproof material.

349,912. Compound-wound Dynamo-Electric Machine; Elihu Thomson, Lynn, Mass. The invention relates to compound-wound dynamos and attachments, whereby the properties of such machines may be varied to suit varied conditions of working. The coarse wire or direct field-wire winding of the compound-wound machine is made of such exciting strength that from light load to full load of current gives an increasing potential at the machine terminals up to, say, twenty per cent. Means are then provided, such as resistance-shunts, around the whole or part of said winding, so that it may be lowered in effect by the shunting devices to the desired degree required for the circumstances of each case. The case assumed is one in which the work is done by current supplied from a distributing centre or centres and taken from the mains at a considerable distance from the generating-station.



349,715. ELECTRIC MOTOR.

(1) 349,926. Circuit Closer for Rails; (2) 349,927. Electric Railway-Signal; Wm. Daves, Cranstons, N. Y. (1) The invention, as illustrated, consists in supporting a circuit-closing bar by means of brackets secured to the rail, and in insulating the bar therefrom in a suitable manner. The bar is so shaped that when a train passes over the track the tread of the wheel will press one end of the bar against the lower flange of the rail with sufficient force to insure a perfect electrical



349,715. ELECTRIC MOTOR.

connection. The bar itself is free to move at both ends, so that there will be no danger of its being broken by the weight of the train. The insulated bar is electrically connected with one pole of a battery, the other pole of which is connected with the rail, and suitable signaling-instruments are designed to be included in the circuit thus formed. (2) The invention consists in constructing an interlocking device for closing a circuit through an alarm or signaling device in such manner that two electro-magnets must be vitalized to complete the circuit. A given one of these electro-magnets must be vitalized before the other in each instance, in order that the device shall respond. If the second is first vitalized, it locks the first magnet so that its armature cannot be actuated, and at the same time the armature of the first holds the other armature in such position as to prevent it from completing the connections of the alarm-circuit.

349,945. Quadruplex Telegraph; Wm. Maver, Jr., Jersey City, N. J., Assignor to the Baltimore & Ohio Telegraph Company, Baltimore, Md. For description, see page 188, this issue.

349,947. Telephone Switch; J. F. Mehren, Chicago, Ill. This is a novel arrangement of the telephone switch-hook. The shifting contact is on the outside, where it can be easily got at for inspection.

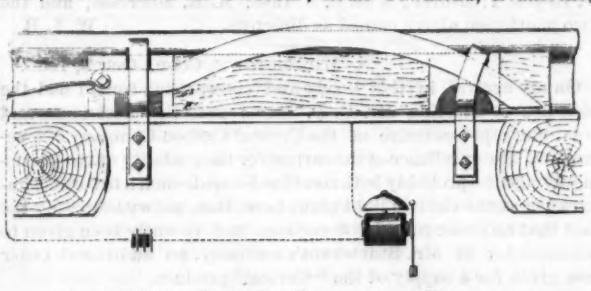
(1) 349,975, (2) 349,976. Automatic Telephone Exchange System; J. H. Bickford, Salem, Mass., Assignor of one-third to S. F. Smith, same place. (1) This is an automatic system designed for villages, with a small number of telephones. He provides a central office containing a series of normally-grounded instruments—one instrument for each subscriber's line leading from the said central office—the instruments comprising suitable means, which, when brought into co-operation, removes the ground-terminals of the instruments one by one at the will of the subscriber, and also establishes a connection with such other instrument as the subscriber may desire, the ground-terminal of the latter instrument being the final one removed. (2) Is an improvement on the former.

349,999. Electric Arc-Lamp Protector; George Jeffery, Detroit, Mich., Assignor to T. P. Tuite, same place. The invention relates to improvements in the construction of lamps, especially designed to be employed as a protection to the electric arc lights, and the mechanism by means of which the feed of the carbons is controlled or actuated.

350,000. Dynamo-Electric Machine; Jabez Jenkins, Philadelphia, Penn. The invention consists in an improved form of drum-armature. Cores of soft iron are placed radially to the shaft and wire wound around the cores.

350,003. Dynamo-Electric Machine; Rankin Kennedy, Paisley, County of Renfrew, Assignor to D. Graham, Glasgow, Scotland. Patented in England. The invention relates to improvements in the collection and distribution of currents or pulsations of electricity, and in the apparatus to be employed therein, and has for its main object to so collect and distribute the currents that a number of separate currents or pulsations may be collected and sent along one main line and afterward distributed in any order or combination to give variable and readily alterable powers and strengths of currents or pulsations.

350,024. Call-Bell Switch; Louis Townsend, Evansville,



349,926. CIRCUIT CLOSER FOR RAILS.

Ind., Assignor of one-half to J. L. Bay and W. B. Worthen, Little Rock, Ark. The object of the invention is to provide a switch wherein the contacts shall be always bright and sure in connecting alternately the ground with the bell-circuit and with the talking-circuit.

350,025. Electric Motor; Roman Vogler, Oberturkheim, Wurtemburg, Germany. The motor consists of two or more pulley-rings having a ring of soft iron upon which are fastened at suitable distances apart on both sides wedge-shaped cheeks of iron and wood. The former are arranged on each armature-ring in such a manner as will allow them to face each other when the rings are properly arranged on a fixed or rotary shaft. The wooden cheeks face outwardly. On that portion of the soft iron rings exposed between the cheeks referred to are wound coils of wire coupled in series. All of the wedge-shaped cheeks of iron are partly held in position by brass plates, each of which is provided with naves upon which are suitably mounted the collectors upon the surfaces of which rest the brushes.

350,046. Electric-Lamp Post; H. M. Doubleday, New York, N. Y., and James Lyman, Middlefield, Conn., Assignors of one-half to J. S. Humbird and Frank S. Marr, both of Harrisburg, Pa. They employ the ordinary gas-lamp post and at the top place a sleeve which supports a rod which holds the incandescent lamp and the line fastenings. Various forms are described.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.